Regio- and Stereoselective Synthesis of a Library of Bioactive Dispiro-Oxindolo/Acenaphthoquino Andrographolides via 1,3-Dipolar Cycloaddition Reaction Under Microwave Irradiation

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Supplymentary information and Documents:

Spectral data of compounds **3a-3l**: 2-9
Spectral data of compounds **4a-4n**: 9-17
Spectral data of compounds **5a-5k**: 17-24
Spectral data of compounds **7-9**: 24-26
Spectral figure of compounds **3a-3l**: 27-63
Spectral figure of compounds **4a-4n**: 64-105
Spectral figure of compounds **5a-5k**: 106-138
Spectral figure of compounds **7-9**: 139-147
2D NMR Spectral figure of compounds **5c, 8, 9**: 148-155

Compound **3a**:

Color: Obtained as white solid;

Mp: 234-236 °C;

IR (KBr, ν_{max}cm^{-1}): 3374, 2938, 2851, 1724, 1619 and 1471;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.30 (1H, dt, *J*=1.2, 7.8 Hz), 7.14 (1H, d, *J*=7.2 Hz), 7.01 (1H, dt, *J*=0.6, 7.8 Hz), 6.85 (1H, d, *J*=7.8 Hz), 4.82 (2H, d, *J*=12 Hz), 4.43 (1H, d, *J*=2.4 Hz), 4.13 (1H, d, *J*=11.4 Hz), 3.76 (1H, d, *J*=10.2 Hz), 3.41 (2H, m), 3.35 (1H, m), 3.18 (1H, dd, *J*=2.4, 10.2 Hz), 3.03 (1H, dd, *J*=6.0, 9.0 Hz), 2.90 (1H, m), 2.53 (1H, m), 2.41 (1H, m), 2.26 (1H, t, *J*=12.6 Hz), 2.04 (1H, m), 2.02 (1H, m), 1.97 (3H, s), 1.82 (3H, m), 1.56 (1H, d, *J*=11.4 Hz), 1.34 (1H, m), 1.28 (2H, m), 1.22 (3H, s), 0.69 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.9 (-CH_3), 23.6 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 29.3 (-CH_2), 35.7 (-CH_3), 38.6 (-CH_2), 39.7 (-CH_2), 40.4 (-CH), 40.5 (-C), 43.9 (-C), 56.4 (-CH), 57.0 (-CH), 61.1 (-CH_2), 65.3 (-CH_2), 66.7 (-C), 73.3 (-CH), 75.4 (-CH_2), 76.8 (-C), 81.4 (-CH), 108.6 (-CH_2), 111.0 (-CH), 123.9 (-CH), 126.9 (-CH), 127.0 (-C), 131.5 (-CH), 144.2 (-C), 148.7 (-C), 179.1 (-C=O), 180.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 525 $[M+H]^+$, 547 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{40}N_2O_6$; m/z 525.2943 $[M+H]^+$ [calcd. 525.2965].

Compound **3b**:

Color: Obtained as white solid;

Mp: 231-233 °C;

IR (KBr, ν_{max}cm^{-1}): 3430, 2942, 2855, 1770, 1698 and 1625;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.11 (1H, d, *J*=7.8 Hz), 6.98 (1H, s), 6.74 (1H, d, *J*=8.4 Hz), 4.82 (2H, d, *J*=9 Hz), 4.42 (1H, d, *J*=1.8 Hz), 4.13 (1H, d, *J*=10.8 Hz), 3.76 (1H, d, *J*=10.2 Hz), 3.41 (2H, m), 3.34 (1H, d, *J*=11.4 Hz), 3.19 (1H, dd, *J*=2.4, 10.2 Hz), 3.02 (1H, dd, *J*=6.0, 8.4 Hz), 2.89 (1H, m), 2.53 (1H, m), 2.41 (1H, m), 2.27 (3H, s), 2.23 (1H, d, *J*=12.6 Hz), 2.00 (2H, m), 1.96 (3H, s), 1.81 (3H, m), 1.56 (1H, d, *J*=11.4 Hz), 1.31 (3H, m), 1.22 (3H, s), 0.69 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.9 (-CH_3), 21.3 (-CH_3), 23.6 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 29.3 (-CH_2), 35.7 (-CH_3), 38.6 (-CH_2), 39.7 (-CH_2), 40.3 (-CH), 40.4 (-C), 43.9 (-C), 56.3 (-CH), 57.0 (-CH), 61.2 (-CH_2), 65.3 (-CH_2), 66.7 (-C), 73.3 (-CH), 75.5 (-CH_2), 76.9 (-C), 81.4

(-CH), 108.6 (-CH_2), 110.8 (-CH), 127.1 (-C), 127.5 (-CH), 131.8 (-CH), 133.7 (-C), 141.7 (-C), 148.7 (-C), 179.1 (-C=O), 180.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 539 $[M+H]^+$, 561 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{31}H_{42}N_2O_6$; m/z 539.3111 $[M+H]^+$ [calcd. 539.3121].

Compound **3c**:

Color: Obtained as white solid;

Mp: 211-213 °C;

IR (KBr, ν_{max}cm^{-1}): 3402, 2940, 2851, 1757, 1720, 1620 and 1474;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.31 (1H, dd, *J*=2.4, 7.8 Hz), 7.11 (1H, d, *J*=2.4 Hz), 6.84 (1H, d, *J*=7.8 Hz), 4.82 (2H, d, *J*=10.8 Hz), 4.61 (1H, s), 4.42 (1H, d, *J*=1.8 Hz), 4.13 (1H, d, *J*=11.4 Hz), 3.82 (1H, d, *J*=10.2 Hz), 3.41 (2H, m), 3.35 (1H, m), 3.23 (1H, dd, *J*=1.8, 10.2 Hz), 3.00 (1H, dd, *J*=6.0, 7.8 Hz), 2.88 (1H, m), 2.51 (1H, m), 2.41 (1H, m), 2.24 (1H, t, *J*=12.6 Hz), 2.03 (1H, m), 1.98 (3H, s), 1.82 (3H, m), 1.56 (1H, d, *J*=11.4 Hz), 1.33 (1H, m), 1.27 (2H, m), 1.22 (3H, s), 0.69 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.9 (-CH_3), 23.6 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 29.3 (-CH_2), 35.7 (-CH_3), 38.6 (-CH_2), 39.7 (-CH_2), 40.3 (-CH), 40.5 (-C), 43.9 (-C), 56.3 (-CH), 57.0 (-CH), 61.2 (-CH_2), 65.3 (-CH_2), 66.9 (-C), 73.1 (-CH), 75.5 (-CH_2), 76.7 (-C), 81.4 (-CH), 108.6 (-CH_2), 112.3 (-CH), 127.2 (-CH), 129.1 (-C), 129.3 (-C), 131.5 (-CH), 143.0 (-C), 148.7 (-C), 178.7 (-C=O), 180.3 (-C=O);

MS [ESI-MS, positive mode]: m/z 559 $[M+H]^+$, 581 $[M+Na]^+$; 583 $[(M+2) +Na]^+$

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}ClN_2O_6$; m/z 559.2580 $[M+H]^+$ [calcd. 559.2575].

Compound **3d**:

Color: Obtained as white solid;

Mp: 213-215 °C;

IR (KBr, ν_{max}cm^{-1}): 3412, 2940, 2855, 1722, 1614 and 1470;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.65 (1H, dd, *J*=1.8, 8.4Hz), 7.41 (1H, d, *J*=1.8 Hz), 6.68 (1H, d, *J*=8.4 Hz), 4.82 (2H, d, *J*=9.0 Hz), 4.61 (2H, s), 4.41 (1H, d, *J*=2.4 Hz), 4.13 (1H, d, *J*=11.4 Hz), 3.82 (1H, d, *J*=10.2 Hz), 3.38 (3H, m), 3.22 (1H, dd, *J*=1.8, 10.2 Hz), 2.99 (1H, m), 2.87

(1H, m), 2.51 (1H, m), 2.40 (1H, m), 2.23 (1H, t, *J*=12.6 Hz), 2.01 (1H, m), 1.98 (3H, s), 1.82 (2H, m), 1.56 (1H, d, *J*=11.4 Hz), 1.29 (3H, m), 1.22 (3H, s), 0.69 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.9 (-CH_3), 23.6 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 29.3 (-CH_2), 35.7 (-CH_3), 38.6 (-CH_2), 39.7 (-CH_2), 40.3 (-CH), 40.5 (-C), 43.9 (-C), 56.3 (-CH), 57.0 (-CH), 61.2 (-CH_2), 65.3 (-CH_2), 66.9 (-C), 73.1 (-CH), 75.5 (-CH_2), 76.4 (-C), 81.4 (-CH), 85.8 (-C), 108.6 (-CH_2), 113.1 (-CH), 129.7 (-C), 135.8 (-CH), 140.4 (-CH), 144.1 (-C), 148.7 (-C), 178.3 (-C=O), 180.3 (-C=O);

MS [ESI-MS, positive mode]: m/z 651 $[M+H]^+$, 673 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}IN_2O_6$; m/z 651.1926 $[M+H]^+$ [calcd. 651.1931].

Compound **3e**:

Color: Obtained as white solid;

Mp: 210-212 °C;

IR (KBr, ν_{max}cm^{-1}): 3400, 2941, 2852, 1762, 1715, 1634 and 1486;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.63 (1H, s, -N*H*), 7.13 (1H, m), 6.82 (1H, dd, *J*=4.8, 8.4 Hz), 6.72 (1H, dd, *J*=2.4, 8.4 Hz), 5.84 (1H, d, *J*=3.6 Hz, 14-O*H*), 5.08 (1H, d, *J*=4.8 Hz, 3-O*H*), 4.75 (2H, d, *J*=10.2 Hz), 4.30 (1H, dd, *J*=2.4, 3.6 Hz), 4.13 (1H, m, 19-O*H*), 3.85 (1H, dd, *J*=2.4, 10.8 Hz), 3.76 (1H, d, *J*=9.6 Hz), 3.31 (1H, t, *J*=8.4 Hz), 3.25 (2H, m), 3.03 (1H, dd, *J*=2.4, 10.2 Hz), 2.85 (1H, dd, *J*=6, 8.4 Hz), 2.63 (1H, m), 2.37 (1H, m), 2.31 (1H, m), 2.13 (1H, t, *J*=12.6 Hz), 1.90 (1H, dd, *J*=4.2, 12.6 Hz), 1.87 (3H, s), 1.84 (1H, m), 1.73 (1H, m), 1.66 (2H, m), 1.45 (1H, d, *J*=10.8 Hz), 1.30 (1H, m), 1.15 (2H, m), 1.09 (3H, s), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.9 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.4 (-CH_2), 28.0 (-CH_2), 34.9 (-CH_3), 36.8 (-CH_2), 38.0 (-CH_2), 38.5 (-CH), 38.8 (-C), 42.3 (-C), 54.3 (-CH), 54.8 (-CH), 59.6 (-CH_2), 62.8 (-CH_2), 65.0 (-C), 70.9 (-CH), 73.5 (-CH_2), 74.4 (-C), 78.6 (-CH), 107.3 (-CH_2), 110.5 (- CH, $^3J_{C\text{-}F}$ 7.5 Hz), 112.6 (-CH, $^2J_{C\text{-}F}$ 24 Hz), 116.5 (-CH, $^2J_{C\text{-}F}$ 22.5 Hz), 127.5 (-C, $^3J_{C\text{-}F}$ 7.5 Hz), 139.2 (-C), 147.6 (-C), 157.8 (-C, $^1J_{C\text{-}F}$ 237 Hz), 176.6 (-C=O), 177.6 (-C=O);

MS [ESI-MS, positive mode]: m/z 543 $[M+H]^+$, 565 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}FN_2O_6$; m/z 543.2888 $[M+H]^+$ [calcd. 543.2870].

Compound **3f**:

Color: Obtained as white solid;

Mp: 224-226 °C;

IR (KBr, ν_{max}cm^{-1}): 3462, 2944, 2854, 1750, 1706, 1642 and 1491;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.40 (1H, s, -N*H*), 6.84 (1H, dd, *J*=2.4, 8.4 Hz), 6.73 (1H, d, *J*=8.4 Hz), 6.57 (1H, d, *J*=3 Hz), 5.77 (1H, d, *J*=4.2 Hz, 14-O*H*), 5.08 (1H, d, *J*=4.8 Hz, 3-O*H*), 4.75 (2H, d, *J*=10.8 Hz), 4.29 (1H, m), 4.13 (1H, dd, *J*=2.4, 7.8 Hz, 19-O*H*), 3.86 (1H, dd, *J*=2.4, 10.8 Hz), 3.72 (1H, d, *J*=10.2 Hz), 3.66 (3H, s), 3.29 (1H, t, *J*=8.4 Hz), 3.26 (1H, dd, *J*=4.2, 10.2 Hz), 3.22 (1H, m), 3.01 (1H, m), 2.85 (1H, dd, *J*=6, 8.4 Hz), 2.63 (1H, qn, *J*=6 Hz), 2.36 (1H, t, *J*=11.4 Hz), 2.31 (1H, d, *J*=12.6 Hz), 2.14 (1H, t, *J*=12.6 Hz), 1.90 (1H, m), 1.85 (4H, m), 1.73 (1H, m), 1.66 (2H, m), 1.45 (1H, d, *J*=11.4 Hz), 1.29 (1H, m), 1.15 (2H, m), 1.09 (3H, s), 0.59 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.9 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.5 (-CH_2), 28.0 (-CH_2), 34.9 (-CH_3), 36.8 (-CH_2), 38.0 (-CH_2), 38.5 (-CH), 38.8 (-C), 42.3 (-C), 54.4 (-CH), 54.8 (-CH), 55.3 (-CH_3), 59.7 (-CH_2), 62.8 (-CH_2), 64.9 (-C), 71.1 (-CH), 73.4 (-CH_2), 74.6 (-C), 78.6 (-CH), 107.4 (-CH_2), 109.9 (-CH), 112.1 (-CH), 114.3 (-CH), 127.0 (-C), 136.1 (-C), 147.6 (-C), 154.7 (-C), 176.5 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 555 $[M+H]^+$, 577 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: $C_{31}H_{42}N_2O_7$; m/z 577.2880 $[M+Na]^+$ [calcd. 577.2890].

Compound **3g**:

Color: Obtained as white solid;

Mp: 209-211 °C;

IR (KBr, ν_{max}cm^{-1}): 3398, 2941, 2850, 1760, 1725, 1617 and 1472;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.46 (1H, dd, *J*=2.4, 8.4 Hz), 7.24 (1H, d, *J*=1.8 Hz), 6.79 (1H, d, *J*=8.4 Hz), 4.82 (2H, d, *J*=10.2 Hz), 4.61 (1H, s), 4.42 (1H, m), 4.13 (1H, d, *J*=10.8 Hz), 3.82 (1H, d, *J*=10.2 Hz), 3.41 (2H, m), 3.34 (1H, d, *J*=10.8 Hz), 3.23 (1H, dd, *J*=2.4, 10.2 Hz), 3.00 (1H, m), 2.90 (1H, m) 2.51 (1H, m), 2.40 (1H, m), 2.24 (1H, m), 1.98 (3H, s), 1.96 (1H, m), 1.82 (5H, m), 1.56 (1H, d, *J*=11.4 Hz), 1.33 (1H, m), 1.26 (2H, m), 1.22 (3H, s), 0.69 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.9 (-CH_3), 23.6 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 29.3 (-CH_2), 35.7 (-CH_3), 38.6 (-CH_2), 39.7 (-CH_2), 40.3 (-CH), 40.5 (-C), 43.9 (-C), 56.3 (-CH), 57.0 (-CH), 61.2 (-CH_2), 65.3 (-CH_2), 66.9 (-C), 73.1 (-CH), 75.5 (-CH_2), 76.6 (-C), 81.4 (-CH), 108.6

(-CH_2), 112.7 (-CH), 116.3 (-C), 129.5 (-C), 130.0 (-CH), 134.4 (-CH), 143.5 (-C), 148.7 (-C), 178.6 (-C=O), 180.3 (-C=O);

MS [ESI-MS, positive mode]: m/z 603 $[M+H]^+$, 605 $[(M+2)+H]^+$, 625 $[M+Na]^+$, 627 $[(M+2)+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}BrN_2O_6$; m/z 625.1905 $[M+Na]^+$ [calcd. 625.1889].

Compound **3h**:

Color: Obtained as white solid;

Mp: 182-184 °C;

IR (KBr, ν_{max}cm^{-1}): 3411, 2938, 2856, 1768, 1709, 1611 and 1467;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 7.36 (1H, m), 7.03 (3H, m), 5.77 (1H, d, *J*=3.6 Hz, 14-O*H*), 5.09 (1H, bd, *J*=13.8 Hz, 3-O*H*), 4.75 (2H, m), 4.19 (1H, m), 4.13 (1H, bd, *J*=11.4 Hz, 19-O*H*), 3.84 (1H, m), 3.65 (1H, d, *J*=10.2 Hz), 3.25 (2H, m), 3.13 (3H, s), 2.91 (1H, m), 2.87 (1H, dd, *J*=6, 8.4 Hz), 2.64 (1H, m), 2.35 (2H, m), 2.21 (1H, t, *J*=13.2 Hz), 1.89 (2H, m), 1.79 (3H, s), 1.69 (2H, m), 1.47 (1H, d, *J*=11.4 Hz), 1.29 (3H, m), 1.16 (2H, m), 1.09 (3H, s), 0.59 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.9 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.5 (-CH_2), 25.8 (-CH_3) 28.0 (-CH_2), 34.8 (-CH_3), 36.9 (-CH_2), 38.0 (-CH_2), 38.5 (-CH), 38.8 (-C), 42.3 (-C), 54.4 (-CH), 54.8 (-CH), 59.7 (-CH_2), 62.8 (-CH_2), 64.8 (-C), 70.9 (-CH), 73.4 (-CH_2), 74.1 (-C), 78.6 (-CH), 107.3 (-CH_2), 108.5 (-CH), 122.5 (-CH), 124.7 (-CH), 124.8 (-C), 130.0 (-CH), 144.3 (-C), 147.6 (-C), 174.8 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: MF: m/z 539 $[M+H]^+$, 561 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{31}H_{42}N_2O_6$; m/z 539.1119 $[M+H]^+$ [calcd. 539.3121]; 561.2973 $[M+Na]^+$ [calcd. 561.2941].

Compound **3i**:

Color: Obtained as white solid;

Mp: 220-222 °C;

IR (KBr, ν_{max}cm^{-1}): 3484, 3270, 2938, 1739 and 1705;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.45 (1H, s, -N*H*), 6.88 (1H, s), 6.63 (1H, s), 5.75 (1H, d, *J*=3.0 Hz), 5.08 (1H, d, *J*=4.8 Hz), 4.75 (2H, d, *J*=11.4 Hz), 4.27 (1H, s), 4.14 (1H, d, *J*=5.4 Hz),

3.86 (1H, d, *J*=9.6 Hz), 3.68 (1H, d, *J*=9.6 Hz), 3.25 (3H, m), 3.01 (1H, d, *J*=9.0 Hz), 2.86 (1H, t, *J*=7.2 Hz), 2.64 (1H, t, *J*=5.4 Hz), 2.37 (1H, t, *J*=11.4 Hz), 2.31 (1H, d, *J*=12.6 Hz), 2.16 (3H, s), 2.15 (3H, s), 2.12 (1H, m), 1.89 (2H, m), 1.83 (3H, s), 1.70 (3H, m), 1.45 (1H, d, *J*=11.4 Hz), 1.30 (1H, m), 1.15 (2H, m), 1.09 (3H, s), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 16.2 (-CH_3), 20.7 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.5 (-CH_2), 28.0 (-CH_2), 34.9 (-CH_3), 36.8 (-CH_2), 38.0 (-CH_2), 38.4 (-C), 38.8 (-CH), 42.3 (-C), 54.4 (-CH), 54.8 (-CH), 59.7 (-CH_2), 62.7 (-CH_2), 64.7 (-C), 71.1 (-CH), 73.4 (-CH_2), 74.5 (-C), 78.6 (-CH), 107.3 (-CH_2), 118.3 (-C), 123.0 (-CH), 125.4 (-C), 130.4 (-C), 131.6 (-CH), 139.9 (-C), 147.6 (-C), 177.1 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 553 $[M+H]^+$, 575 $[M+Na]^+$

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{44}N_2O_6$; m/z 553.3309 $[M+H]^+$ [calcd. 553.3278]

Compound **3j**:

Color: Obtained as white solid;

Mp: 248-250 °C;

IR (KBr, ν_{max}cm^{-1}): 3362, 2970, 2850, 1736 and 1642;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 11.13 (1H, s, -N*H*), 7.20 (1H, t, *J*=9.6 Hz), 6.99 (1H, dt, *J*=4.8, 7.8 Hz), 6.82 (1H, d, *J*=7.8 Hz), 5.83 (1H, d, *J*=3.6 Hz, 14-O*H*), 5.08 (1H, d, *J*=4.8 Hz, 3-O*H*), 4.75 (2H, d, *J*=9.6 Hz), 4.29 (1H, s), 4.12 (1H, m, 19-O*H*), 3.86 (1H, d, *J*=10.8 Hz), 3.74 (1H, d, *J*=10.2 Hz), 3.27 (2H, m), 3.16 (1H, d, *J*=4.8 Hz), 3.04 (1H, d, *J*=8.4 Hz), 2.86 (1H, dd, *J*=6.0, 8.4 Hz), 2.65 (1H, m), 2.36 (1H, t, *J*=11.4 Hz), 2.31 (1H, d, *J*=12.6 Hz), 2.13 (1H, t, *J*=12.6 Hz), 1.90 (1H, m), 1.85 (3H, s), 1.69 (3H, m), 1.46 (1H, d, *J*=10.8 Hz), 1.30 (1H, m), 1.15 (3H, m), 1.09 (3H, s), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz):): δ 15.0 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.4 (-CH_2), 28.0 (-CH_2), 34.8 (-CH_3), 36.8 (-CH_2), 38.0 (-CH_2), 38.5 (-C), 38.8 (-CH), 42.3 (-C), 54.4 (-CH), 54.8 (-CH), 59.5 (-CH_2), 62.8 (-CH_2), 65.0 (-C), 70.9 (-CH), 73.5 (-CH_2), 74.5 (-C), 78.6 (-CH), 107.3 (-CH_2), 117.0 (- CH, $^2J_{C\text{-}F}$=16.5 Hz), 121.6 (-CH),), 122.8 (-CH, $^3J_{C\text{-}F}$=6.0 Hz), 128.5 (-C, $^3J_{C\text{-}F}$=3.0 Hz), 130.0 (-C, $^2J_{C\text{-}F}$=13.5 Hz), 145.9 (-C, $^1J_{C\text{-}F}$=241.5 Hz), 147.6 (-C), 176.5 (-C=O), 177.5 (-C=O);

MS [ESI-MS, positive mode]: m/z 543$[M+H]^+$, 565$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}FN_2O_6$; m/z 543.2874 $[M+H]^+$ [calcd. 543.2870]; 565.2694 $[M+Na]^+$ [calcd. 565.2690]

Compound **3k**:

Color: Obtained as white solid;

Mp: 232-234 °C;

IR (KBr, ν_{max}cm^{-1}): 3416, 2938, 2849, 1732 and 1452;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.89 (1H, s, -NH), 7.48 (1H, dd, *J*=1.2, 7.2 Hz), 6.95 (2H, m), 5.85 (1H, d, *J*=4.2 Hz), 5.08 (1H, d, *J*=4.8 Hz), 4.75 (2H, d, *J*=10.2 Hz), 4.28 (1H, dd, *J*=2.4, 3.6 Hz), 4.14 (1H, dd, *J*=3.0, 7.2 Hz), 3.86 (1H, dd, *J*=2.4, 11.4 Hz), 3.75 (1H, d, *J*=10.2 Hz), 3.32 (1H, t, *J*=7.8 Hz), 3.24 (2H, m), 3.16 (1H, d, *J*=5.4 Hz) 3.00 (1H, dd, *J*=2.4, 9.6 Hz), 2.86 (1H, dd, *J*=6.0, 8.4 Hz) 2.65 (1H, m), 2.34 (2H, m), 2.12 (1H, t, *J*=12.6 Hz), 1.91 (1H, m), 1.86 (3H, s), 1.73 (1H, m), 1.66 (2H, m), 1.46 (1H, d, *J*=11.4 Hz), 1.31 (1H, dq, *J*=4.2, 13.2 Hz), 1.16 (2H, m), 1.09 (3H, s), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.9 ($-CH_3$), 23.1 ($-CH_3$), 24.1 ($-CH_2$), 24.4 ($-CH_2$), 28.0 ($-CH_2$), 34.8 ($-CH_3$), 36.8 ($-CH_2$), 38.0 ($-CH_2$), 38.4 (-CH), 38.8 (-C), 42.3 (-C), 54.3 (-CH), 54.8 (-CH), 59.5 ($-CH_2$), 62.7 ($-CH_2$), 65.1 (-C), 70.9 (-CH), 73.4 ($-CH_2$), 75.0 (-C), 78.6 (-CH), 101.9 (-C), 107.3 ($-CH_2$), 123.6 (-CH), 124.2 (-CH), 127.5 (-C), 132.9 (-CH), 142.1 (-C), 147.5 (-C), 176.6 (-C=O), 177.4 (-C=O);

MS [ESI-MS, positive mode]: m/z 603$[M+H]^+$, 605$[M+2+H]^+$, 625$[M+Na]^+$, 627$[M+2+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{30}H_{39}BrN_2O_6$; 625.1857 $[M+Na]^+$ [calcd. 625.1889]

Compound **3l**:

Color: Obtained as white solid;

Mp: 198-200 °C;

IR (KBr, ν_{max}cm^{-1}): 3425, 2938, 2849, 1768, 1717 and 1460;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 7.60 (2H, t, *J*=7.8 Hz), 7.51 (1H, t, *J*=7.2 Hz), 7.42 (2H, d, *J*=7.2 Hz), 7.31 (1H, m), 7.12 (2H, m), 6.64 (1H, d, *J*=7.8 Hz), 5.85 (1H, d, *J*=3.6 Hz), 5.06 (1H, d, *J*=4.8 Hz), 4.78 (1H, s), 4.76 (1H, s), 4.36 (1H, m), 4.13 (1H, dd, *J*=3.0, 7.8 Hz), 3.84 (1H, dd, *J*=2.4, 10.8 Hz), 3.79 (1H, d, *J*=9.6 Hz), 3.40 (1H, t, *J*=7.8 Hz), 3.22 (2H, m), 3.16 (1H, d, *J*=8.4 Hz), 2.89 (1H, dd, *J*=6.0, 8.4 Hz), 2.71 (1H, qn, *J*=6.0 Hz), 2.40 (1H, t, *J*=10.8 Hz), 2.32 (1H, m),

2.12 (1H, t, *J*=12.6 Hz), 1.96 (3H, s), 1.90 (1H, dt, *J*=4.2, 12.6 Hz), 1.79 (1H, m), 1.72 (1H, m), 1.61 (2H, m), 1.47 (1H, d, *J*=11.4 Hz), 1.30 (1H, dq, *J*=3.6, 13.2 Hz), 1.16 (1H, m), 1.12 (1H, m), 1.01 (3H, s), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.9 (-CH_3), 23.1 (-CH_3), 24.1 (-CH_2), 24.6 (-CH_2), 27.9 (-CH_2), 34.8 (-CH_3), 36.8 (-CH_2), 38.0 (-CH_2), 38.5 (-CH), 38.8 (-C), 42.3 (-C), 54.4 (-CH), 54.8 (-CH), 59.8 (-CH_2), 62.7 (-CH_2), 65.3 (-C), 71.0 (-CH), 73.6 (-CH_2), 74.2 (-C), 78.6 (-CH), 107.3 (-CH_2), 109.0 (-CH), 123.3 (-CH), 124.6 (-C), 125.3 (-CH), 127.2 (2×-CH), 128.6 (-CH), 129.8 (2×-CH), 130.2 (-CH), 133.6 (-C), 144.2 (-C), 147.6 (-C), 174.5 (-C=O), 177.6 (-C=O);

MS [ESI-MS, positive mode]: m/z 601 $[M+H]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{44}N_2O_6$; m/z 601.3298 $[M+H]^+$ [calcd. 601.3278].

Compound **4a**:

Color: Obtained as white solid;

Mp: 180-182 °C;

IR (KBr, ν_{max}cm^{-1}): 3353, 2938, 2873, 1766, 1698, 1620 and 1472;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.36 (1H, dd, *J*=1.2, 7.8Hz), 7.17 (2H, m), 6.98 (1H, d, *J*=7.8 Hz), 4.81 (1H, t, *J*=8.4 Hz), 4.61 (1H, t, *J*=8.4 Hz), 4.52 (1H, s), 4.15 (1H, m) 3.99 (1H, d, *J*=10.8 Hz), 3.94 (1H, t, *J*=9 Hz), 3.61 (1H, s), 3.35 (2H, dd, *J*=3.0, 11.4 Hz), 3.25 (1H, d, *J*=10.8 Hz), 2.86 (1H, m), 2.69 (1H, m), 2.22 (1H, m), 1.92 (1H, m), 1.71(9H, m), 1.26 (1H, m), 1.19 (1H, m), 1.16 (1H, m), 1.14 (3H, s), 1.00 (2H, m), 0.45 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 (-CH_3), 20.8 (-CH_2), 23.5 (-CH_3), 25.7 (-CH_2), 26.4 (-CH_2), 29.1 (-CH_2), 29.7 (-CH_2), 38.3 (-CH_2), 39.4 (-CH_2), 40.7 (-C), 43.8 (-C), 49.6 (-CH), 50.2 (-CH_2), 54.0 (-CH), 56.8 (-CH), 57.6 (-C), 65.0 (-CH_2), 66.3 (-CH), 68.4 (-CH), 70.4 (-CH_2), 77.8 (-C), 80.9 (-CH), 107.3 (-CH_2), 112.1 (-CH), 124.0 (-CH), 127.8 (-CH), 129.0 (-C), 131.4 (-CH), 143.8 (-C), 148.2 (-C), 179.7 (-C=O), 183.9 (-C=O);

MS [ESI-MS, positive mode]: m/z 551 $[M+H]^+$, 573 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{42}N_2O_6$; m/z 573.2940 $[M+Na]^+$ [calcd. 573 .2941].

Compound **4b**:

Color: Obtained as white solid;

Mp: 181-183 °C;

IR (KBr, ν_{max}cm^{-1}): 3376, 2937, 1769, 1694, 1624 and 1491;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.18 (1H, dd, *J*=0.6, 8.4 Hz), 6.99 (1H, s), 6.87 (1H, d, *J*=7.8 Hz), 4.80 (1H, dd, *J*=8.4, 9.0 Hz), 4.60 (1H, t, *J*=7.8 Hz), 4.53 (1H, s), 4.17 (1H, m), 3.99 (1H, d, *J*=11.4 Hz), 3.93 (1H, t, *J*=9.0 Hz), 3.61 (1H, s), 3.32 (2H, m), 3.25 (1H, d, *J*=11.4Hz), 2.88 (1H, m), 2.69 (1H, m), 2.37 (3H, s), 2.23 (1H, m), 1.92 (1H, m), 1.71 (10H, m), 1.26 (1H, m), 1.14 (4H, m), 1.00 (2H, m), 0.45 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 (-CH_3), 20.8 (-CH_2), 21.4 (-CH_3), 23.5 (-CH_3), 25.7 (-CH_2), 26.4 (-CH_2), 29.1 (-CH_2), 29.7 (-CH_2), 38.3 (-CH_2), 39.4 (-CH_2), 40.7 (-C), 43.8 (-C), 49.7 (-CH), 50.2 (-CH_2), 54.0 (-CH), 56.9 (-CH), 57.8 (-C), 65.0 (-CH_2), 66.2 (-CH), 68.4 (-CH), 70.4 (-CH_2), 77.9 (-C), 80.9 (-CH), 107.1 (-CH_2), 111.9 (-CH), 128.4 (-CH), 129.1 (-C), 131.6 (-CH), 133.8 (-C), 141.3 (-C), 148.3 (-C), 179.8 (-C=O), 183.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 565 $[M+H]^+$, 587 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{33}H_{44}N_2O_6$; m/z 565.3283 $[M+H]^+$ [calcd 565.3278], 587.3094 $[M+Na]^+$ [calcd. 587.3097].

Compound **4c**:

Color: Obtained as white solid;

Mp: 178-180 °C;

IR (KBr, ν_{max}cm^{-1}): 3346, 2940, 1773, 1699, 1619 and 1477;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.39 (1H, dd, *J*=2.4, 8.4 Hz), 7.16 (1H, d, *J*=2.4 Hz), 6.97 (1H, d, *J*=8.4 Hz), 4.80 (1H, dd, *J*=8.4, 9 Hz), 4.61 (1H, t, *J*=8.4 Hz), 4.58 (1H, s), 4.17 (1H, dd, *J*=6.0, 10.2 Hz), 3.99 (1H, d, *J*=10.8 Hz), 3.93 (1H, t, *J*=9 Hz), 3.63 (1H, s), 3.35 (1H, dd, *J*=3.6, 11.4 Hz), 3.27 (2H, m), 2.82 (1H, m), 2.71 (1H, m), 2.25 (1H, m), 1.93 (1H, m), 1.76 (5H, m), 1.65 (4H, m), 1.27 (1H, d, *J*=11.4 Hz), 1.20 (1H, dt, *J*=4.8, 12.6 Hz), 1.15 (4H, m), 1.00 (2H, m), 0.46 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 (-CH_3), 20.9 (-CH_2), 23.5 (-CH_3), 25.7 (-CH_2), 26.4 (-CH_2), 29.1 (-CH_2), 29.6 (-CH_2), 38.3 (-CH_2), 39.4 (-CH_2), 40.7 (-C), 43.8 (-C), 49.7 (-CH), 50.1 (-CH_2), 54.0 (-CH), 56.9 (-CH), 57.7 (-C), 65.0 (-CH_2), 66.3 (-CH), 68.4 (-CH), 70.5 (-CH_2), 77.7 (-C), 80.9 (-CH), 106.9 (-CH_2), 113.4 (-CH), 127.9 (-CH), 129.4 (-C), 131.1 (-C), 131.3 (-CH), 142.6 (-C), 148.5 (-C), 179.6 (-C=O), 183.5 (-C=O);

MS [ESI-MS, positive mode]: m/z 585 $[M+H]^+$, 587 $[(M+2)+H]^+$ 607 $[M+Na]^+$, 609 $[(M+2)+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}ClN_2O_6$; m/z 607.2518 $[M+Na]^+$ [calcd. 607.2551].

Compound **4d**:

Color: Obtained as white solid;

Mp: 184-186 °C;

IR (KBr, ν_{max}cm^{-1}): 3406, 2938, 1766, 1703, 1613 and 1472;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.72 (1H, dd, *J*=1.2, 8.4 Hz), 7.46 (1H, d, *J*=1.2 Hz), 6.81 (1H, d, *J*=8.4 Hz), 4.79 (1H, dd, *J*=7.8, 9 Hz), 4.60 (3H, m), 4.17 (1H, dd, *J*=5.4, 9.6 Hz), 3.99 (1H, d, *J*=11.4 Hz), 3.93 (1H, t, *J*=9 Hz), 3.66 (1H, s), 3.36 (1H, m), 3.27 (2H, m), 2.81 (1H, m), 2.70 (1H, m), 2.25 (1H, m), 1.91 (1H, m), 1.73 (6H, m), 1.61 (2H, m), 1.26 (1H, d, *J*=10.8Hz), 1.20 (1H, m), 1.14 (4H, m), 1.02 (2H, m), 0.46 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 ($-CH_3$), 21.0 ($-CH_2$), 23.5 ($-CH_3$), 25.7 ($-CH_2$), 26.5 ($-CH_2$), 29.1 ($-CH_2$), 29.6 ($-CH_2$), 38.2 ($-CH_2$), 39.4 ($-CH_2$), 40.7 (-C), 43.8 (-C), 49.7 (-CH), 50.2 ($-CH_2$), 54.0 (-CH), 56.9 (-CH), 57.8 (-C), 65.0 ($-CH_2$), 66.2 (-CH), 68.4 (-CH), 70.5 ($-CH_2$), 77.4 (-C), 80.9 (-CH), 85.7 (-C), 107.0 ($-CH_2$), 114.2 (-CH), 131.8 (-C), 136.6 (-CH), 140.3 (-CH), 143.6 (-C), 148.5 (-C), 179.6 (-C=O), 183.0 (-C=O);

MS [ESI-MS, positive mode]: m/z 677 $[M+H]^+$, 699 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}IN_2O_6$; m/z 677.2083 $[M+H]^+$ [calcd 677.2088].

Compound **4e**:

Color: Obtained as white solid;

Mp: 179-181 °C;

IR (KBr, ν_{max}cm^{-1}): 3374, 2938, 1767, 1700, 1630 and 1486;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.13 (1H, dt, *J*=2.4, 9.0 Hz), 6.97 (2H, m), 4.81 (1H, dd, *J*=7.8, 9.0 Hz), 4.61 (1H, t, *J*=7.8 Hz), 4.58 (1H, s), 4.15 (1H, dd, *J*=5.4, 9.6 Hz), 3.99 (1H, d, *J*=11.4Hz), 3.94 (1H, t, *J*=9Hz), 3.63 (1H, s), 3.35 (1H, dd, *J*=3.6, 11.4 Hz), 3.27 (2H, m), 2.83 (1H, m), 2.72 (1H, m), 2.24 (1H, m), 1.93 (1H, m), 1.76 (3H, m), 1.71 (3H, m), 1.63 (1H, m), 1.27 (1H, d, *J*=11.4 Hz), 1.19 (5H, m), 1.01 (2H, m), 0.46 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 (-CH_3), 20.8 (-CH_2), 23.5 (-CH_3), 25.7 (-CH_2), 26.4 (-CH_2), 29.1 (-CH_2), 29.6 (-CH_2), 38.3 (-CH_2), 39.4 (-CH_2), 40.7 (-C), 43.8 (-C), 49.7 (-CH), 50.0 (-CH_2), 54.0 (-CH), 56.8 (-CH), 57.6 (-C), 65.0 (-CH_2), 66.4 (-CH), 68.4 (-CH), 70.4 (-CH_2), 78.1 (-C), 80.9 (-CH), 106.9 (-CH_2), 113.0 (-CH, $^3J_{C\text{-}F}$ 7.5Hz), 115.2 (-CH, $^2J_{C\text{-}F}$ 25.5Hz), 117.7 (-CH, $^2J_{C\text{-}F}$ 24Hz), 131.0 (-C, $^3J_{C\text{-}F}$ 7.5Hz), 139.8 (-C), 148.4 (-C), 160.64 (-C, $^1J_{C\text{-}F}$ 238.5Hz), 179.6 (-C=O), 183.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 569 $[M+H]^+$, 591 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}FN_2O_6$; m/z 569.3010 $[M+H]^+$ [calcd 569.3027], 591.2856 $[M+Na]^+$ [calcd. 591.2846].

Compound **4f**:

Color: Obtained as white solid;

Mp: 180-182 °C;

IR (KBr, ν_{max}cm^{-1}): 3347, 2938, 1767, 1695 and 1490;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.69 (1H, s, -N*H*), 6.93 (1H, dd, *J*=2.4, 9.0 Hz), 6.87 (1H, d, *J*=8.4 Hz), 6.68 (1H, s), 6.60 (1H, d, *J*=2.4 Hz), 5.04 (1H, d, *J*=4.8 Hz), 4.62 (2H, m), 4.48 (1H, s), 4.06 (1H, m), 3.99 (1H, m), 3.84 (1H, t, *J*=8.4 Hz), 3.75 (3H, s), 3.72 (1H, d, *J*=9.6 Hz), 3.51 (1H, s), 3.15 (3H, m), 2.69 (1H, m), 2.56 (1H, m), 2.15 (1H, m), 1.83 (1H, m), 1.58 (8H, m), 1.46 (1H, m), 1.17 (2H, m), 1.10 (1H, m), 1.00 (3H, s), 0.90 (1H, dd, *J*=1.8, 12.6 Hz), 0.83 (1H, m), 0.36 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.1 (-CH_3), 18.9 (-CH_2), 23.0 (-CH_3), 24.3 (-CH_2), 25.1 (-CH_2), 27.8 (-CH_2), 28.1 (-CH_2), 36.4 (-CH_2), 37.8 (-CH_2), 42.2 (-C), 47.5 (-CH), 48.3 (-CH_2), 51.7 (-CH), 54.8 (-CH), 55.4 (-C), 55.8 (-CH_3, -C) 62.6 (-CH_2), 64.5 (-CH), 66.4 (-CH), 68.6 (-CH_2), 76.1 (-C), 78.2 (-CH), 105.4 (-CH_2), 111.3 (-CH), 112.4 (-CH), 114.9 (-CH), 128.8 (-C), 135.4 (-C), 147.0 (-C), 155.3 (-C), 177.1 (-C=O), 181.5 (-C=O);

MS [ESI-MS, positive mode]: m/z 581 $[M+H]^+$, 603 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{33}H_{44}N_2O_7$; m/z 603.2988 $[M+Na]^+$ [calcd. 603.3046].

Compound **4g**:

Color: Obtained as white solid;

Mp: 182-184 °C;

IR (KBr, ν_{max}cm^{-1}): 3352, 2941, 1775, 1698, 1617 and 1474;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.53 (1H, dd, *J*=1.8Hz, 7.8Hz), 7.29 (1H, d, *J*=1.8Hz), 6.92 (1H, d, *J*=7.8Hz), 4.80 (1H, m), 4.60 (2H, m), 4.17 (1H, m), 3.99 (1H, d, *J*=10.8Hz), 3.93 (1H, t, *J*=9Hz), 3.64 (1H, s), 3.35 (1H, m), 3.28 (2H, m), 2.82 (1H, m), 2.71 (1H, m), 2.25 (1H, m), 1.92 (1H, m), 1.69 (9H, m), 1.26 (1H, d, *J*=11.4Hz), 1.17 (5H, m), 1.15 (3H, s), 1.14 (1H, m), 1.01 (2H, m), 0.46 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.1 (-CH_3), 20.9 (-CH_2), 23.5 (-CH_3), 25.7 (-CH_2), 26.5 (-CH_2), 29.1 (-CH_2), 29.6 (-CH_2), 38.3 (-CH_2), 39.4 (-CH_2), 40.7 (-C), 43.8 (-C), 49.7 (-CH), 50.1 (-CH_2), 54.0 (-CH), 56.9 (-CH), 57.8 (-C), 65.0 (-CH_2), 66.2 (-CH), 68.4 (-CH), 70.5 (-CH_2), 77.7 (-C), 80.9 (-CH), 106.9 (-CH_2), 113.8 (-CH), 116.4 (-C), 130.7 (-CH), 131.5 (-C), 134.3 (-CH), 143.1 (-C), 148.5 (-C), 179.6 (-C=O), 183.3 (-C=O);

MS [ESI-MS, positive mode]: m/z 629 $[M+H]^+$, 631 $[(M+2) +H]^+$, 651 $[M+Na]^+$, 653 $[(M+2) +Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}BrN_2O_6$; m/z 651.2007 $[M+Na]^+$ [calcd. 651.2046].

Compound **4h**:

Color: Obtained as white solid;

Mp: 208-210 °C;

IR (KBr, ν_{max}cm^{-1}): 3321, 2950, 2885, 1771, 1700, 1610 and 1469;

^{1}H NMR (CD_3OD, 600 MHz): δ 7.47 (1H, m), 7.25 (2H, m), 7.10 (1H, d, *J*=7.8 Hz), 4.82 (1H, dd, *J*=8.4, 9Hz), 4.61 (1H, t, *J*=7.8 Hz), 4.53 (1H, s), 4.17 (1H, dd, *J*=6.6, 9Hz), 3.97 (1H, d, *J*=11.4 Hz), 3.94 (1H, t, *J*=9 Hz), 3.69 (1H, s), 3.37 (1H, dd, *J*=4.2, 10.2 Hz), 3.32 (1H, m), 3.24 (1H, d, *J*=11.4 Hz), 3.19 (3H, s), 2.83 (1H, m), 2.66 (1H, m), 2.19 (1H, m), 1.93 (1H, m), 1.71 (7H, m), 1.57 (2H, m), 1.20 (1H, m), 1.15 (1H, m), 1.13 (1H, m), 1.12 (3H, s), 0.99 (1H, m), 0.93 (1H, dd, *J*=2.4, 12.6 Hz), 0.43 (3H, s);

^{13}C NMR (CD_3OD, 150 MHz): δ 15.0 (-CH_3), 21.1 (-CH_2), 23.5 (-CH_3), 25.6 (-CH_2), 26.3 (-CH_2), 26.8 (-CH_3), 29.0 (-CH_2), 29.6 (-CH_2), 38.1 (-CH_2), 39.3 (-CH_2), 40.8 (-C), 43.7 (-C), 49.8 (-CH), 50.2 (-CH_2), 53.9 (-CH), 56.9 (-CH), 58.0 (-C), 65.0 (-CH_2), 66.1 (-CH), 68.5 (-CH), 70.5 (-CH_2), 77.2 (-C), 80.9 (-CH), 107.1 (-CH_2), 110.9 (-CH), 124.5 (-CH), 127.4 (-CH), 128.7 (-C), 131.5 (-CH), 145.6 (-C), 148.5 (-C), 179.6 (-C=O), 181.6 (-C=O);

MS [ESI-MS, positive mode]: m/z 565 $[M+H]^+$, 587 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{33}H_{44}N_2O_6$; m/z 565.3285 $[M+H]^+$ [calcd 565.3278], 587.3078 $[M+Na]^+$ [calcd. 587.3097].

Compound **4i**:

Color: Obtained as white solid;

Mp: 196-198 °C;

IR (KBr, ν_{max}cm^{-1}): 3268, 2925, 1775, 1704 and 1602;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 7.61 (2H, t, *J*=7.8 Hz), 7.51 (1H, t, *J*=7.8 Hz), 7.38(3H, m), 7.27 (2H, m), 6.82 (1H, d, *J*=7.8 Hz), 6.16 (1H, s), 5.03 (1H, d, *J*=5.4 Hz), 4.70 (1H, t, *J*=8.4 Hz), 4.62 (1H, t, *J*=7.8 Hz), 4.46 (1H, s), 4.07 (2H, m), 3.87 (1H, t, *J*=9.0 Hz), 3.73 (1H, dd, *J*=2.4, 10.8 Hz), 3.48 (1H, s), 3.27 (1H, dd, *J*=3.0, 10.8 Hz), 3.17 (2H, m), 2.78 (1H, m), 2.64 (1H, m), 2.14 (1H, m), 1.90 (1H, m), 1.64 (7H, m), 1.54 (2H, m), 1.23 (1H, m), 1.17 (1H, m), 1.10 (1H, m), 1.04 (1H, m), 1.00 (3H, s), 0.88 (1H, m), 0.41 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.0 (-CH_3), 19.1 (-CH_2), 23.0 (-CH_3), 24.3 (-CH_2), 25.0 (-CH_2), 27.86 (-CH_2), 27.87 (-CH_2), 36.3 (-CH_2), 37.8 (-CH_2), 40.1 (-C), 42.3 (-C), 48.1 (-CH_2), 49.1 (-CH), 51.7 (-CH), 54.8 (-CH), 55.4 (-C), 62.6 (-CH_2), 64.8 (-CH), 66.6 (-CH), 68.7 (-CH_2), 75.4 (-C), 78.2 (-CH), 105.7 (-CH_2), 110.0 (-CH), 123.7 (-CH), 126.3 (-CH), 126.5 (3×-CH), 126.8 (-C), 128.7 (-CH), 129.9 (-CH), 130.0 (-CH), 133.4 (-C), 143.3 (-C), 146.9 (-C), 177.1 (-C=O), 179.1 (-C=O);

MS [ESI-MS, positive mode]: m/z 627$[M+H]^+$, 649$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{38}H_{46}N_2O_6$; m/z 627.3461 $[M+H]^+$ [calcd. 627.3434]; 649.3256 $[M+Na]^+$ [calcd. 649.3254].

Compound **4j**:

Color: Obtained as white solid;

Mp: 206-208 °C;

IR (KBr, ν_{max}cm^{-1}): 3299, 2937, 1767, 1686 and 1608;

^{1}H NMR ($CDCl_3$, 600 MHz): δ 7.29 (6H, m), 7.15 (2H, m), 6.84 (1H, d, *J*=7.8 Hz), 6.78 (1H, bs), 5.10 (1H, d, *J*=15.6 Hz), 4.83 (1H, t, *J*=9.0 Hz), 4.66 (1H, dt, *J*=15.6 Hz), 4.60 (1H, t, *J*=7.8 Hz), 4.52 (1H, s), 4.18 (1H, bs), 4.07 (1H, d, *J*=11.4 Hz), 3.99 (1H, t, *J*=9.0 Hz), 3.46 (1H, s),

3.43 (1H, dd, *J*=4.2, 10.2 Hz),, 3.37 (1H, d, *J*=9.6 Hz), 3.21 (1H, m), 2.82 (2H, m), 2.59 (1H, bs), 2.24 (1H, m), 1.91 (1H, m), 1.80 (2H, m), 1.73 (6H, m), 1.64 (2H, m), 1.22 (1H, m), 1.18 (3H, s), 1.05 (3H, m), 0.88 (1H, m), 0.31 (3H, s);

^{13}C NMR ($CDCl_3$, 150 MHz): δ 14.4 (-CH_3), 19.5 (-CH_2), 22.5 (-CH_3), 24.1 (-CH_2), 25.3 (-CH_2), 28.1 (-CH_2), 28.6 (-CH_2), 36.9 (-CH_2), 37.7 (-CH_2), 39.2 (-C), 42.8 (-C), 44.2 (-CH_2), 48.0 (-CH), 48.9 (-CH_2), 52.4 (-CH), 55.1 (-CH), 55.7 (-C), 64.0 (-CH_2), 65.2 (-CH), 67.0 (-CH), 69.3 (-CH_2), 76.0 (-C), 80.4 (-CH), 106.5 (-CH_2), 110.0 (-CH), 123.1 (-CH), 126.2 (-CH), 127.1 (-C), 127.4 (2×-CH), 127.9 (-CH), 128.9 (2×-CH), 129.9 (-CH), 135.2 (-C), 143.0 (-C), 146.1 (-C), 177.5 (-C=O), 180.5 (-C=O);

MS [ESI-MS, positive mode]: m/z 641$[M+H]^+$, 663$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{39}H_{48}N_2O_6$; m/z 641.3591 $[M+H]^+$ [calcd. 641.3591].

Compound **4k**:

Color: Obtained as white solid;

Mp: 178-180 °C;

IR (KBr, ν_{max}cm^{-1}): 3318, 2937, 1765, 1695 and 1479;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.75 (1H, s, -NH), 7.20 (1H, m), 6.95 (1H, s), 6.74 (1H, s), 6.71 (1H, s), 5.11 (1H, d, *J*=4.8 Hz), 4.63 (1H, t, *J*=8.4 Hz), 4.58 (1H, t, *J*=7.8 Hz), 4.46 (1H, s), 4.14 (1H, dd, *J*=2.4, 7.8 Hz), 3.99 (1H, m), 3.83 (1H, t, *J*=8.4 Hz), 3.71 (1H, dd, *J*=2.4, 10.8 Hz), 3.14 (3H, m), 2.66 (1H, m), 2.28 (3H, s), 2.18 (3H, s), 2.13 (1H, m), 1.80 (1H, m), 1.53 (9H, m), 1.22 (1H, m), 1.11 (3H, m), 0.99 (3H, s), 0.85 (2H, m), 0.34 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.3 (-CH_3), 16.4 (-CH_3), 19.2 (-CH_2), 20.8 (-CH_3), 23.1 (-CH_3), 24.4 (-CH_2), 25.2 (-CH_2), 27.9 (-CH_2), 28.3 (-CH_2), 36.5 (-CH_2), 37.9 (-CH_2), 40.0 (-C), 42.4 (-C), 47.7 (-CH), 48.5 (-CH_2), 51.8 (-CH), 54.9 (-CH), 55.7 (-C), 62.8 (-CH_2), 64.6 (-CH), 66.7 (-CH), 68.8 (-CH_2), 76.1 (-C), 78.4 (-CH), 105.8 (-CH_2), 119.9 (-C), 124.1 (-CH), 127.5 (-C), 131.5 (-C), 131.6 (-CH), 138.4 (-C), 146.9 (-C), 177.5 (-C=O), 182.4 (-C=O);

MS [ESI-MS, positive mode]: m/z 579$[M+H]^+$, 601$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{34}H_{46}N_2O_6$; m/z 601.3210 $[M+Na]^+$ [calcd. 601.3254].

Compound **4l**:

Color: Obtained as white solid;

Mp: 179-181 °C;

IR (KBr, ν_{max}cm^{-1}): 3342, 2939, 1765, 1708 and 1643;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 11.37 (1H, s, -NH), 7.27 (1H, m), 7.14 (1H, dt, *J*=4.8, 7.8 Hz), 6.98 (1H, dd, *J*=0.6, 7.2 Hz), 6.39 (1H, s), 5.08 (1H, d, *J*=4.8 Hz), 4.65 (1H, t, *J*=8.4 Hz), 4.62 (1H, t, *J*=7.8 Hz), 4.44 (1H, s), 4.07 (1H, dd, *J*=3.0, 7.8 Hz), 3.99 (1H, dd, *J*=6.0, 9.6 Hz), 3.86 (1H, t, *J*= 8.4 Hz), 3.72 (1H, dd, *J*=2.4, 11.4 Hz), 3.45 (1H, s), 3.17 (3H, m), 2.62 (1H, m), 2.57 (1H, m), 2.14 (1H, m), 1.82 (1H, m), 1.56 (9H, m), 1.14 (3H, m), 1.01 (3H, s), 0.88 (2H, m), 0.37 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.2 (-CH_3), 19.0 (-CH_2), 23.0 (-CH_3), 24.2 (-CH_2), 24.9 (-CH_2), 27.8 (-CH_2), 27.9 (-CH_2), 36.4 (-CH_2), 37.7 (-CH_2), 39.1 (-C), 42.2 (-C), 47.9 (-CH), 48.2 (-CH_2), 51.8 (-CH), 54.8 (-CH), 55.2 (-C), 62.6 (-CH_2), 64.8 (-CH), 66.5 (-CH), 68.6 (-CH_2), 76.0 (-C), 78.2 (-CH), 105.5 (-CH_2), 116.8 (-CH, $^{2}J_{C\text{-}F}$=16.5Hz), 122.1 (-CH), 123.3 (-CH, $^{3}J_{C\text{-}F}$= 6 Hz), 129.3 (-C, $^{2}J_{C\text{-}F}$=12 Hz), 130.7 (-C), 146.7 (-C), 146.8 (-C, $^{1}J_{C\text{-}F}$=243 Hz), 177.0 (-C=O), 181.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 569$[M+H]^+$, 591$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}FN_2O_6$; m/z 569.3053 $[M+H]^+$ [calcd. 569.3027].

Compound **4m**:

Color: Obtained as white solid;

Mp: 170-172 °C;

IR (KBr, ν_{max}cm^{-1}): 3382, 2938, 1767, 1708 and 1452;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 11.12 (1H, s, -NH), 7.54 (1H, d, *J*=7.8 Hz), 7.13 (1H, d, *J*=7.2 Hz), 7.08 (1H, t, *J*=7.8 Hz), 6.37 (1H, s), 5.04 (1H, d, *J*=4.8 Hz), 4.66 (1H, t, *J*=8.4 Hz), 4.61 (1H, t, *J*=7.8 Hz), 4.46 (1H, s), 4.07 (1H, dd, *J*=3.0, 7.2 Hz), 3.99 (1H, m), 3.86 (1H, t, *J*= 8.4 Hz), 3.72 (1H, dd, *J*=3.0, 10.8 Hz), 3.49 (1H, s), 3.14 (3H, m), 2.62 (1H, m), 2.57 (1H, m), 2.14 (1H, m), 1.82 (1H, m), 1.58 (9H, m), 1.15 (3H, m), 1.00 (3H, s), 0.88 (2H, m), 0.37 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.2 (-CH_3), 19.1 (-CH_2), 23.0 (-CH_3), 24.3 (-CH_2), 24.9 (-CH_2), 27.8 (-CH_2), 27.9 (-CH_2), 36.3 (-CH_2), 37.7 (-CH_2), 40.0 (-C), 42.2 (-C), 48.09 (-CH), 48.1 (-CH_2), 51.8 (-CH), 54.8 (-CH), 55.3 (-C), 62.6 (-CH_2), 64.7 (-CH), 66.5 (-CH), 68.7 (-CH_2), 76.4 (-C), 78.2 (-CH), 103.1 (-C), 105.6 (-CH_2), 124.0 (-CH), 125.2 (-CH), 129.7 (-C), 132.7 (-CH), 141.5 (-C), 146.8 (-C), 177.0 (-C=O), 181.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 629 $[M+H]^+$, 631 $[(M+2)+H]^+$, 651 $[M+Na]^+$, 653 $[(M+2)+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}BrN_2O_6$; m/z 629.2244 $[M+H]^+$ [calcd.629.2226].

Compound **4n**:

Color: Obtained as white solid;

Mp: 168-170 °C;

IR (KBr, ν_{max}cm^{-1}): 3366, 2938, 1766, 1706 and 1446;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.80 (1H, s, -NH), 7.70 (1H, d, *J*=7.8 Hz), 7.11 (1H, d, *J*=7.2 Hz), 6.93 (1H, t, *J*=7.8 Hz), 6.41 (1H, s), 5.03 (1H, d, *J*=5.4 Hz), 4.66 (1H, t, *J*=8.4 Hz), 4.61 (1H, t, *J*=7.8 Hz), 4.46 (1H, s), 4.07 (1H, dd, *J*=2.4, 7.8 Hz), 3.99 (1H, dd, *J*=5.4, 10.2 Hz), 3.86 (1H, t, *J*= 8.4 Hz), 3.72 (1H, dd, *J*=3.0, 10.8 Hz), 3.49 (1H, s), 3.14 (3H, m), 2.61 (1H, m), 2.54 (1H, m), 2.14 (1H, m), 1.82 (1H, m), 1.54 (9H, m), 1.13 (3H, m), 1.00 (3H, s), 0.88 (2H, m), 0.37 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 14.2 ($-CH_3$), 19.1 ($-CH_2$), 23.0 ($-CH_3$), 24.2 ($-CH_2$), 24.9 ($-CH_2$), 27.8 ($-CH_2$), 27.9 ($-CH_2$), 36.3 ($-CH_2$), 37.7 ($-CH_2$), 40.0 (-C), 42.2 (-C), 48.1 ($-CH_2$), 48.2 (-CH), 51.8 (-CH), 54.8 (-CH), 55.3 (-C), 62.6 ($-CH_2$), 64.7 (-CH), 66.5 (-CH), 68.6 ($-CH_2$), 76.1 (-C), 76.7 (-C), 78.2 (-CH), 105.6 ($-CH_2$), 124.3 (-CH), 125.6 (-CH), 128.8 (-C), 138.7 (-CH), 145.1 (-C), 146.8 (-C), 177.0 (-C=O), 181.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 677$[M+H]^+$, 699$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{41}IN_2O_6$; m/z 699.1918 $[M+Na]^+$ [calcd. 699.1907].

Compound **5a**:

Color: Obtained as white solid;

Mp: 238-240 °C;

IR (KBr, ν_{max}cm^{-1}): 3376, 2938, 2842, 1764 and 1703;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.60 (1H, s, -N*H*), 7.25 (3H, m), 7.18 (3H, m), 7.14 (1H, d, *J*=7.8 Hz), 6.98 (1H, t, *J*=7.8 Hz), 6.82 (1H, d, *J*=7.2 Hz), 5.85 (1H, d, *J*=3.6 Hz), 5.08 (1H, d, *J*=4.8 Hz), 4.84 (1H, s), 4.70 (1H, s), 4.36 (1H, m), 4.12 (1H, dd, *J*=3.0, 7.8 Hz), 3.84 (1H, dd, *J*=2.4, 10.8 Hz), 3.76 (1H, d, *J*=10.2 Hz), 3.20 (4H, m), 3.12 (2H, m), 2.73 (1H, q, *J*=4.2 Hz),

2.54 (1H, m), 2.25 (3H, m), 1.82 (2H, m), 1.66 (3H, m), 1.34 (1H, m), 1.25 (1H, m), 1.06 (1H, m), 1.04 (3H, s), 1.00 (1H, m), 0.59 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 23.0 (-CH_3), 24.0 (-CH_2), 24.1 (-CH_2), 28.0 (-CH_2), 36.9 (-CH_2), 37.9 (-CH_2), 38.7 (-CH), 38.8 (-C), 42.3 (-C), 52.4 (-CH_2), 54.4 (-CH), 54.6 (-CH), 56.2 (-CH_2), 62.7 (-CH_2), 65.0 (-C), 70.9 (-CH), 73.5 (-C), 73.7 (-CH_2), 78.6 (-CH), 107.5 (-CH_2), 109.8 (-CH), 121.9 (-CH), 125.3 (-CH), 125.7 (-C), 126.8 (-CH), 127.6 (2×-CH), 128.1 (2×-CH), 130.0 (-CH), 138.8 (-C), 143.0 (-C), 147.6 (-C), 177.2 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 601 $[M+H]^+$, 623 $[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{44}N_2O_6$; m/z 623.3118 $[M+Na]^+$ [calcd. 623.3097].

Compound **5b**:

Color: Obtained as white solid;

Mp: 238-240 °C;

IR (KBr, ν_{max}cm^{-1}): 3388, 2941, 2849, 1763 and 1714;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.50 (1H, s, -N*H*), 7.25 (2H, m), 7.19 (3H, m), 7.06 (1H, d, *J*=8.4 Hz), 6.95 (1H, s), 6.72 (1H, d, *J*=7.8 Hz), 5.86 (1H, d, *J*=3.6 Hz), 5.10 (1H, d, *J*=4.8 Hz), 4.84 (1H, s), 4.70 (1H, s), 4.35 (1H, m), 4.14 (1H, dd, *J*=3.0, 7.8 Hz), 3.84 (1H, dd, *J*=2.4, 10.8 Hz), 3.76 (1H, d, *J*=9.6 Hz), 3.17 (5H, m), 3.12 (2H, m), 2.72 (1H, q, *J*=4.2 Hz), 2.24 (3H, m), 2.21 (3H, s), 1.82 (2H, m), 1.66 (3H, m), 1.32 (1H, m), 1.25 (1H, dq, *J*=3.6, 12.6 Hz), 1.06 (1H, m), 1.03 (3H, s), 0.99 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.1 (-CH_3), 21.0 (-CH_3), 23.0 (-CH_3), 24.0 (-CH_2), 24.1 (-CH_2), 28.1 (-CH_2), 37.0 (-CH_2), 38.0 (-CH_2), 38.8 (-CH), 38.9 (-C), 42.4 (-C), 52.5 (-CH_2), 54.5 (-CH), 54.7 (-CH), 56.3 (-CH_2), 62.8 (-CH_2), 65.1 (-C), 71.0 (-CH), 73.6 (-C), 73.9 (-CH_2), 78.7 (-CH), 107.5 (-CH_2), 109.6 (-CH), 125.8 (-C), 125.9 (-CH), 126.9 (-CH), 127.7 (2×-CH), 128.2 (2×-CH), 130.4 (-C), 130.7 (-CH), 139.0 (-C), 140.6 (-C), 147.7 (-C), 177.3 (-C=O), 177.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 615$[M+H]^+$, 637$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{37}H_{46}N_2O_6$; m/z 637.3235 $[M+Na]^+$ [calcd. 637.3254].

Compound **5c**:

Color: Obtained as white solid;

Mp: 227-229 °C;

IR (KBr, ν_{max}cm^{-1}): 3386, 2942, 2849, 1763 and 1720;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.76 (1H, s, -N*H*), 7.34 (1H, m), 7.26 (2H, t, *J*=7.2 Hz), 7.19 (3H, m), 7.07 (1H, d, *J*=2.4 Hz), 6.84 (1H, d, *J*= 8.4 Hz), 5.93 (1H, d, *J*=3.6 Hz), 5.08 (1H, d, *J*=4.8 Hz), 4.85 (1H, s), 4.71 (1H, s), 4.36 (1H, m), 4.12 (1H, dd, *J*=2.4, 7.8 Hz), 3.84 (2H, m), 3.18 (6H, m), 2.73 (1H, q, *J*=4.2 Hz), 2.53 (1H, m), 2.24 (3H, m), 1.81 (2H, m), 1.66 (3H, m), 1.33 (1H, m), 1.25 (1H, dq, *J*=3.6, 13.2 Hz), 1.06 (1H, m), 1.03 (3H, s), 0.98 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 23.0 (-CH_3), 23.8 (-CH_2), 24.1 (-CH_2), 28.0 (-CH_2), 36.9 (-CH_2), 37.9 (-CH_2), 38.8 (-CH), 38.9 (-C), 42.3 (-C), 52.4 (-CH_2), 54.3 (-CH), 54.6 (-CH), 56.2 (-CH_2), 62.8 (-CH_2), 65.4 (-C), 70.8 (-CH), 73.6 (-C), 73.7 (-CH_2), 78.6 (-CH), 107.5 (-CH_2), 111.4 (-CH), 125.1 (-CH), 125.9 (-C), 126.9 (-CH), 127.6 (2×-CH), 127.8 (-C), 128.2 (2×-CH), 130.0 (-CH), 138.6 (-C), 142.0 (-C), 147.6 (-C), 176.9 (-C=O), 177.6 (-C=O);

MS [ESI-MS, positive mode]: m/z 635$[M+H]^+$, 637$[M+2+H]^+$, 657$[M+Na]^+$, 659$[M+2+Na]^+$

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}ClN_2O_6$; m/z 657.2732 $[M+Na]^+$ [calcd. 657.2707].

Compound **5d**:

Color: Obtained as white solid;

Mp: 206-208 °C;

IR (KBr, ν_{max}cm^{-1}): 3385, 2938, 2848, 1720 and 1613;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.73 (1H, s, -N*H*), 7.61 (1H, dd, *J*=1.2, 7.8 Hz), 7.37 (1H, s), 7.26 (2H, t, *J*=7.8 Hz), 7.19 (3H, m), 6.68 (1H, d, *J*=7.8 Hz), 5.91 (1H, d, *J*=3.6 Hz), 5.07 (1H, d, *J*=4.8 Hz), 4.85 (1H, s), 4.71 (1H, s), 4.34 (1H, m), 4.12 (1H, m), 3.83 (2H, m), 3.19 (7H, m), 2.72 (1H, dd, *J*=3.6, 8.4 Hz), 2.24 (3H, m), 1.82 (2H, m), 1.66 (3H, m), 1.33 (1H, m), 1.25 (1H, m), 1.06 (1H, m), 1.04 (3H, s), 0.98 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 23.0 (-CH_3), 23.9 (-CH_2), 24.1 (-CH_2), 28.0 (-CH_2), 36.9 (-CH_2), 37.9 (-CH_2), 38.8 (-CH), 38.9 (-C), 42.3 (-C), 52.5 (-CH_2), 54.3 (-CH), 54.6 (-CH), 56.2 (-CH_2), 62.7 (-CH_2), 65.4 (-C), 70.8 (-CH), 73.4 (-C), 73.7 (-CH_2), 78.6 (-CH), 84.8 (-C), 107.5 (-CH_2), 112.3 (-CH), 126.9 (-CH), 127.6 (2×-CH), 128.2 (2×-CH), 128.3 (-C), 133.5 (-CH), 138.5 (-C), 138.6 (-CH), 142.8 (-C), 147.6 (-C), 176.5 (-C=O), 177.6 (-C=O);

MS [ESI-MS, positive mode]: m/z 727[M+H]$^+$, 749[M+Na]$^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}IN_2O_6$; m/z 727.2252 [M+H]$^+$ [calcd. 727.2244]; 749.2064 [M+Na]$^+$ [calcd. 749.2064].

Compound **5e**:

Color: Obtained as white solid;

Mp: 226-228 $^{\circ}$C;

IR (KBr, ν_{max}cm^{-1}): 3368, 2933, 2857, 1786 and 1704;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.66 (1H, s, -N*H*), 7.25 (2H, t, *J*=7.2 Hz), 7.19 (3H, m), 7.12 (1H, dt, *J*=3.0, 9.0 Hz), 6.88 (1H, dd, *J*=2.4, 8.4 Hz), 6.83 (1H, q, *J*=4.2 Hz), 5.93 (1H, d, *J*=3.0 Hz), 5.09 (1H, d, *J*=4.8 Hz), 4.84 (1H, s), 4.70 (1H, s), 4.37 (1H, m), 4.14 (1H, dd, *J*=2.4, 7.2 Hz), 3.83 (2H, m), 3.18 (7H, m), 2.73 (1H, m), 2.24 (3H, m), 1.80 (2H, m), 1.66 (3H, m), 1.33 (1H, d, *J*=10.8 Hz), 1.25 (1H, m), 1.07 (1H, m), 1.03 (3H, s), 0.98 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.1 (-CH_3), 23.0 (-CH_3), 23.9 (-CH_2), 24.1 (-CH_2), 28.1 (-CH_2), 36.9 (-CH_2), 38.0 (-CH_2), 38.8 (-CH), 38.9 (-C), 42.3 (-C), 52.5 (-CH_2), 54.4 (-CH), 54.7 (-CH), 56.2 (-CH_2), 62.8 (-CH_2), 65.4 (-C), 70.9 (-CH), 73.7 (-C), 73.8 (-CH_2), 78.7 (-CH), 107.5 (-CH_2), 110.9 (-CH, $^3J_{C-F}$=7.5 Hz), 112.8 (-CH, $^2J_{C-F}$=20.5 Hz), 116.7 (-CH, $^2J_{C-F}$=24 Hz), 127.0 (CH), 127.6 (-C, $^3J_{C-F}$=7.5 Hz), 127.7 (2×-CH), 128.2 (2×-CH), 138.7 (-C), 139.3 (-C), 147.6 (-C), 157.8 (-C, $^1J_{C-F}$=237 Hz), 177.2 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 619[M+H]$^+$, 641[M+Na]$^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}FN_2O_6$; m/z 641.3024 [M+Na]$^+$ [calcd. 641.3003].

Compound **5f**:

Color: Obtained as white solid;

Mp: 218-220 $^{\circ}$C;

IR (KBr, ν_{max}cm^{-1}): 3383, 2938, 2844, 1762 and 1711;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.45 (1H, s, -N*H*), 7.25 (2H, t, *J*=7.8 Hz), 7.19 (3H, m), 6.85 (1H, dd, *J*=2.4, 8.4 Hz), 6.76 (1H, s), 6.74 (1H, t, *J*=3.6 Hz), 5.87 (1H, d, *J*=3.6 Hz), 5.10 (1H, d, *J*=4.8 Hz), 4.83 (1H, s), 4.70 (1H, s), 4.36 (1H, m), 4.14 (1H, dd, *J*=2.4, 7.8 Hz), 3.84 (1H, dd, *J*=2.4, 10.8 Hz), 3.78 (1H, d, *J*=10.2 Hz), 3.66 (3H, s), 3.35 (1H, m), 3.19 (6H, m), 2.72

(1H, q, *J*=4.2 Hz), 2.24 (3H, m), 1.81 (2H, m), 1.66 (3H, m), 1.32 (1H, m), 1.24 (1H, dq, *J*=3.6, 12.6 Hz), 1.06 (1H, dd, J=2.4, 12.6 Hz), 1.03 (3H, s), 0.99 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.1 (-CH_3), 23.0 (-CH_3), 24.0 (-CH_2), 24.1 (-CH_2), 28.1 (-CH_2), 37.0 (-CH_2), 38.0 (-CH_2), 38.8 (-CH), 38.9 (-C), 42.3 (-C), 52.4 (-CH_2), 54.4 (-CH), 54.7 (-CH), 55.4 (-OMe), 56.3 (-CH_2), 62.8 (-CH_2), 65.2 (-C), 71.0 (-CH), 73.7 (-C), 74.1 (-CH_2), 78.7 (-CH), 107.6 (-CH_2), 110.1 (-CH), 112.6 (-CH), 114.1 (-CH), 126.9 (CH), 127.2 (-C), 127.6 (2×-CH), 128.2 (2×-CH), 136.2 (-C), 138.9 (-C), 147.6 (-C), 154.7 (-C), 177.1 (-C=O), 177.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 631$[M+H]^+$, 653$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{37}H_{46}N_2O_7$; m/z 653.3237 $[M+Na]^+$ [calcd. 653.3203].

Compound **5g**:

Color: Obtained as white solid;

Mp: 226-228 °C;

IR (KBr, ν_{max}cm^{-1}): 3391, 2939, 2851, 1722 and 1617;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.78 (1H, s, -N*H*), 7.46 (1H, dd, *J*=1.8, 8.4 Hz) 7.25 (2H, m), 7.18 (4H, m), 6.80 (1H, d, *J*=8.4 Hz), 5.97 (1H, d, *J*=3.6 Hz), 5.13 (1H, d, *J*=4.8 Hz), 4.83 (1H, s), 4.70 (1H, s), 4.35 (1H, m), 4.18 (1H, dd, *J*=2.4, 7.2 Hz), 3.83 (2H, m), 3.17 (7H, m), 2.72 (1H, dd, *J*=3.6, 8.4 Hz), 2.22 (3H, m), 1.80 (2H, m), 1.66 (3H, m), 1.32 (1H, d, *J*=10.8 Hz), 1.24 (1H, dq, *J*=3.6, 13.2 Hz), 1.06 (1H, m), 1.03 (3H, s), 0.97 (1H, m), 0.58 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.2 (-CH_3), 23.1 (-CH_3), 24.0 (-CH_2), 24.2 (-CH_2), 28.1 (-CH_2), 37.0 (-CH_2), 38.1 (-CH_2), 38.9 (-CH), 39.0 (-C), 42.4 (-C), 52.6 (-CH_2), 54.5 (-CH), 54.8 (-CH), 56.4 (-CH_2), 62.9 (-CH_2), 65.6 (-C), 70.9 (-CH), 73.7 (-CH_2), 73.9(-C), 78.8 (-CH), 107.8 (-CH_2), 112.1 (-CH), 113.8 (-C), 127.2 (-CH), 128.0 (2×-CH), 128.2 (-CH), 128.3 (-C), 128.4 (2×-CH), 133.1 (-CH), 138.7 (-C), 142.5 (-C), 147.7 (-C), 177.1 (-C=O), 177.8 (-C=O);

MS [ESI-MS, positive mode]: m/z 679$[M+H]^+$, 681$[M+2+H]^+$, 701$[M+Na]^+$, 703$[M+2+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}BrN_2O_6$; m/z 701.2189 $[M+Na]^+$ [calcd. 701.2202].

Compound **5h**:

Color: Obtained as white solid;

Mp: 232-234 °C;

IR (KBr, ν_{max}cm^{-1}): 3307, 2935, 1762, 1715 and 1478;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.48 (1H, s, -N*H*), 7.25 (2H, m), 7.18 (3H, t, *J*=7.2 Hz), 6.89 (1H, s), 6.79 (1H, s), 5.83 (1H, d, *J*=3.6 Hz), 5.07 (1H, d, *J*=4.2 Hz), 4.85 (1H, s), 4.70 (1H, s), 4.36 (1H, bs), 4.12 (1H, d, *J*=7.8 Hz), 3.84 (1H, d, *J*=10.8 Hz), 3.75 (1H, d, *J*=9.6 Hz), 3.16 (6H, m), 2.73 (1H, q, *J*=4.2 Hz), 2.26 (3H, m), 2.18 (3H, s), 2.14 (3H, s), 2.07 (1H, s), 1.81 (2H, m), 1.66 (3H, m), 1.34 (1H, d, *J*=10.2 Hz), 1.25 (1H, m), 1.07 (1H, m), 1.04 (3H, s), 0.99 (1H, m), 0.59 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 16.2 (-CH_3), 20.8 (-CH_3), 23.0 (-CH_3), 23.9 (-CH_2), 24.1 (-CH_2), 28.0 (-CH_2), 36.9 (-CH_2), 37.9 (-CH_2), 38.7 (-CH), 38.8 (-C), 42.3 (-C), 52.5 (-CH_2), 54.4 (-CH), 54.6 (-CH), 56.2 (-CH_2), 62.8 (-CH_2), 65.1 (-C), 71.0 (-CH), 73.6 (-C), 73.9 (-CH_2), 78.6 (-CH), 107.5 (-CH_2), 118.7 (-C), 123.1 (-CH), 125.5 (-C), 126.8 (-CH), 127.6 (2×-CH), 128.1 (2×-CH), 130.4 (-C), 131.8 (-CH), 138.9 (-C), 139.0 (-C), 147.6 (-C), 177.68 (-C=O), 177.74 (-C=O);

MS [ESI-MS, positive mode]: m/z 629$[M+H]^+$, 651$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{32}H_{42}N_2O_6$; m/z 629.3598 $[M+H]^+$ [calcd. 629.3591]; 651.3410 $[M+Na]^+$ [calcd. 651.3410].

Compound **5i**:

Color: Obtained as white solid;

Mp: 249-251 $^{\circ}$C;

IR (KBr, ν_{max}cm^{-1}): 3275, 2940, 1785, 1725 and 1643;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 11.13 (1H, s, -N*H*), 7.24 (2H, m), 7.19 (4H, dd, *J*=7.8, 14.4 Hz), 7.02 (2H, m), 5.91 (1H, d, *J*=3.6 Hz), 5.08 (1H, d, *J*=4.2 Hz), 4.84 (1H, s), 4.71 (1H, s), 4.37 (1H, s), 4.12 (1H, d, *J*=7.2 Hz), 3.83 (2H, dd, *J*=10.2, 25.8 Hz), 3.19 (6H, m), 2.75 (1H, dd, *J*=3, 7.8 Hz), 2.53 (1H, m), 2.26 (3H, m), 1.81 (2H, m), 1.66 (3H, m), 1.33 (1H, d, *J*=10.8 Hz), 1.26 (1H, m), 1.07 (1H, m), 1.04 (3H, s), 1.00 (1H, m), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 23.0 (-CH_3), 23.8 (-CH_2), 24.1 (-CH_2), 28.0 (-CH_2), 36.9 (-CH_2), 37.9 (-CH_2), 38.7 (-CH), 38.9 (-C), 42.3 (-C), 52.4 (-CH_2), 54.3 (-CH), 54.6 (-CH), 56.1 (-CH_2), 62.7 (-CH_2), 65.3 (-C), 70.8 (-CH), 73.7 (-CH_2), 73.8 (-C), 78.6 (-CH), 107.5 (-CH_2), 117.1 (-CH, $^{2}J_{C\text{-}F}$=16.5 Hz), 121.4 (-CH), 122.8 (-CH, $^{3}J_{C\text{-}F}$=4.5 Hz), 126.9 (-CH), 127.7

(2×-CH), 128.1 (2×-CH), 128.6 (-C, $^{3}J_{C\text{-}F}$=3.0 Hz), 130.1 (-C, $^{2}J_{C\text{-}F}$=12 Hz), 138.6 (-C), 146.1 (-C, $^{1}J_{C\text{-}F}$=241.5 Hz), 147.5 (-C), 177.2 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 619$[M+H]^+$, 641$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}FN_2O_6$; m/z 619.3201 $[M+H]^+$ [calcd. 619.3183].

Compound **5j**:

Color: Obtained as white solid;

Mp: 248-250 °C;

IR (KBr, ν_{max}cm^{-1}): 3555, 3380, 2933, 1744 and 1447;

^{1}H NMR (DMSO-*d*$_6$, 600 MHz): δ 10.88 (1H, s, -N*H*), 7.48 (1H, d, *J*=8.4 Hz), 7.24 (2H, t, *J*=7.8 Hz), 7.20 (1H, d, *J*=7.2 Hz), 7.17 (2H, d, *J*=7.8 Hz), 7.13 (1H, m), 6.96 (1H, t, *J*=7.8 Hz), 5.93 (1H, d, *J*=3.6 Hz), 5.07 (1H, d, *J*=4.8 Hz), 4.84 (1H, s), 4.71 (1H, s), 4.36 (1H, m), 4.12 (1H, dd, *J*=2.4, 7.2 Hz), 3.84 (1H, m), 3.82 (1H, d, *J*=10.2 Hz), 3.24 (2H, m), 3.19 (2H, m), 3.13 (2H, m), 2.75 (1H, q, *J*=4.2 Hz), 2.52 (1H, m), 2.25 (3H, m), 1.83 (2H, m), 1.66 (3H, m), 1.35 (1H, d, *J*=10.8 Hz), 1.26 (1H, dq, *J*=3.6, 12.6 Hz), 1.08 (1H, dd, *J*=1.8, 13.2 Hz), 1.04 (3H, s), 1.01 (1H, m), 0.60 (3H, s);

^{13}C NMR (DMSO-*d*$_6$, 150 MHz): δ 15.0 (-CH_3), 23.0 (-CH_3), 23.9 (-CH_2), 24.0 (-CH_2), 28.0 (-CH_2), 36.8 (-CH_2), 37.9 (-CH_2), 38.7 (-CH), 38.9 (-C), 42.3 (-C), 52.5 (-CH_2), 54.3 (-CH), 54.6 (-CH), 56.1 (-CH_2), 62.7 (-CH_2), 65.5 (-C), 70.8 (-CH), 73.6 (-CH_2), 74.4 (-C), 78.6 (-CH), 102.2 (-C), 107.5 (-CH_2), 123.6 (-CH), 124.4 (-CH), 126.9 (-CH), 127.6 (2×-CH), 127.7 (-C), 128.1 (2×-CH), 132.9 (-CH), 138.5 (-C), 142.2 (-C), 147.5 (-C), 177.1 (-C=O), 177.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 679$[M+H]^+$, 681$[M+2+H]^+$, 701$[M+Na]^+$, 703$[M+2+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{36}H_{43}BrN_2O_6$; m/z 701.2224 $[M+Na]^+$ [calcd. 701.2202].

Compound **5k**:

Color: Obtained as white solid;

Mp: 196-198 °C;

IR (KBr, ν_{max}cm^{-1}): 3417, 2938, 1768, 1722 and 1604;

^{1}H NMR ($CDCl_3$, 600 MHz): δ 7.52 (3H, m), 7.42 (1H, m), 7.24 (2H, dd, *J*=1.2, 7.8 Hz), 7.21 (3H, m), 7.19 (3H, d, *J*=7.8 Hz), 7.12 (1H, dt, *J*=0.6, 7.8 Hz), 6.66 (1H, d, *J*=7.8 Hz), 4.79 (2H, d,

J=1.2 Hz), 4.67 (1H, dd, *J*=1.2, 3.0 Hz), 4.13 (1H, d, *J*=11.4 Hz), 3.91 (1H, dd, *J*=1.2, 10.2 Hz), 3.58 (1H, dd, *J*=3.0, 10.2 Hz), 3.53 (2H, m), 3.41 (1H, d, *J*=9.0 Hz), 3.38 (1H, m), 3.26 (1H, m), 2.99 (1H, dd, *J*=4.8, 9.0 Hz), 2.88 (1H, m), 2.40 (1H, t, *J*=12.6 Hz), 2.33 (1H, m), 2.16 (1H, dd, *J*=1.8, 11.4 Hz), 1.98 (1H, m), 1.84 (1H, dt, *J*=4.8, 11.4 Hz), 1.75 (4H, m), 1.46 (1H, d, *J*=11.4 Hz), 1.23 (2H, m), 1.18 (3H, s), 1.12 (3H, m), 0.61 (3H, s);

^{13}C NMR ($CDCl_3$, 150 MHz): δ 15.3 (-CH_3), 22.7 (-CH_3), 24.1 (-CH_2), 24.6 (-CH_2), 28.4 (-CH_2), 37.0 (-CH_2), 38.3 (-CH_2), 39.1 (-C), 40.6 (-CH), 42.9 (-C), 53.2 (-CH_2), 54.8 (-CH), 55.4 (-CH), 57.1 (-CH_2), 64.2 (-CH_2), 65.7 (-C), 72.6 (-CH), 73.0 (-CH_2), 74.6 (-C), 80.8 (-CH), 108.0 (-CH_2), 109.4 (-CH), 123.9 (-CH), 124.7 (-C), 126.57 (-CH), 126.62 (-CH), 126.7 (-CH), 127.07 (-CH), 127.12 (-CH), 128.2 (-CH), 128.3 (-CH), 128.6 (-CH), 128.7 (-CH), 129.8 (-CH), 129.9 (-CH), 130.1 (-CH), 133.8 (-C), 138.5 (-C), 144.2 (-C), 147.0 (-C), 176.0 (-C=O), 177.1 (-C=O);

MS [ESI-MS, positive mode]: m/z 677$[M+H]^+$, 699$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{42}H_{48}N_2O_6$; m/z 677.3590 $[M+H]^+$ [calcd. 677.3591].

Compound **7**:

Color: Obtained as white solid;

Mp: 228-230 °C;

IR (KBr, ν_{max}cm^{-1}): 3494, 3358, 2943, 1772 and 1701;

^{1}H NMR ($CDCl_3$, 600 MHz): δ 8.15 (1H, d, *J*= 7.8 Hz), 7.92 (1H, m), 7.88 (1H, d, *J*=6.6 Hz), 7.74 (1H, t, *J*=7.8 Hz), 7.69 (2H, m), 4.85 (1H, s), 4.73 (1H, s), 4.48 (1H, bs), 4.23 (1H, d, *J*=10.8 Hz), 3.64 (1H, dd, *J*=1.8, 10.2 Hz), 3.56 (2H, m), 3.34 (1H, d, *J*=11.4 Hz), 3.15 (1H, m), 3.11 (1H, m), 2.90 (1H, dd, *J*=3.6, 10.2 Hz), 2.43 (2H, m), 2.38 (1H, d, *J*=12 Hz), 2.26 (1H, m), 2.14 (1H, m), 2.02 (1H, d, *J*=12 Hz), 1.98 (3H, s), 1.92 (3H, m), 1.81 (1H, m), 1.61 (1H, m), 1.42 (1H, d, *J*=9.6 Hz), 1.34 (1H, m), 1.29 (1H, m), 1.27 (3H, s), 1.24 (1H, m), 0.69 (3H, s);

^{13}C NMR ($CDCl_3$, 150 MHz): 15.3 (-CH_3), 22.7 (-CH_3), 24.0 (-CH_2), 24.9 (-CH_2), 28.5 (-CH_2), 35.3 (-CH_3), 37.0 (-CH_2), 38.3 (-CH_2), 39.1 (-C), 40.7 (-CH), 43.0 (-C), 54.8 (-CH), 55.5 (-CH), 60.3 (-CH_2), 64.3 (-CH_2), 65.0 (-C), 72.0 (-CH), 72.7 (-CH_2), 79.0 (-C), 80.9 (-CH), 108.0 (-CH_2), 121.0 (-CH), 123.6 (-CH), 125.8 (-CH), 128.2 (-CH), 129.2 (-CH), 130.4 (-C), 130.9 (-C), 132.7 (-CH), 135.0 (-C), 142.6 (-C), 146.6 (-C), 177.4 (-C=O), 207.5 (-C=O);

MS [ESI-MS, positive mode]: m/z 560$[M+H]^+$, 582$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{31}H_{41}NO_6$; m/z 560.3025 $[M+H]^+$ [calcd. 560.3012]; 582.2833 $[M+Na]^+$ [calcd. 582.2832].

Compound **8**:

Color: Obtained as white solid;

Mp: 231-233 °C;

IR (KBr, ν_{max}cm^{-1}): 3446, 2940, 1759, 1714 and 1443;

^{1}H NMR ($CDCl_3$, 600 MHz): δ 8.14 (1H, d, *J*= 7.8 Hz), 7.90 (2H, m), 7.78 (1H, d, *J*=7.2 Hz), 7.74 (1H, dd, *J*=7.2, 7.8 Hz), 7.69 (1H, dd, *J*= 7.2, 8.4 Hz), 7.18 (5H, m), 4.80 (2H, d, *J*=10.8 Hz), 4.53 (1H, bs), 4.21 (1H, d, *J*= 11.4 Hz), 3.63 (1H, m), 3.57 (1H, m), 3.48 (1H, t, *J*=7.8 Hz), 3.31 (2H, m), 3.18 (1H, d, *J*= 13.8 Hz), 2.97 (2H, m), 2.84 (1H, dd, *J*= 3, 10.2 Hz), 2.80 (1H, bs), 2.49 (2H, t, *J*=13.6 Hz), 2.35 (1H, m), 2.18 (2H, m), 2.13 (1H, m), 1.90 (2H, m), 1.85 (1H, m), 1.78 (1H, m), 1.51 (1H, d, *J*=10.8 Hz), 1.27 (1H, m), 1.23 (3H, s), 1.18 (2H, m), 0.69 (3H, s);

^{13}C NMR ($CDCl_3$, 150 MHz): 15.4 ($-CH_3$), 22.6 ($-CH_3$), 23.9 ($-CH_2$), 24.5 ($-CH_2$), 28.5 ($-CH_2$), 37.0 ($-CH_2$), 38.2 ($-CH_2$), 39.1 (-C), 40.4 (-CH), 42.9 (-C), 53.1 ($-CH_2$), 54.7 (-CH), 55.3 (-CH), 57.1 ($-CH_2$), 64.3 ($-CH_2$), 65.8 (-C), 72.0 (-CH), 73.1 ($-CH_2$), 78.2 (-C), 80.8 (-CH), 108.0 ($-CH_2$), 121.4 (-CH), 123.5 (-CH), 125.8 (-CH), 126.9 (-CH), 127.9 (2×-CH), 128.1 (2×-CH), 128.2 (-CH), 129.2 (-CH), 130.4 (-C), 130.9 (-C), 132.6 (-CH), 135.0 (-C), 138.8 (-C), 142.6 (-C), 146.9 (-C), 177.4 (-C=O), 207.0 (-C=O);

MS [ESI-MS, positive mode]: m/z 636$[M+H]^+$, 658$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{40}H_{45}NO_6$; m/z 636.3314 $[M+H]^+$ [calcd. 636.3325].

Compound **9**:

Color: Obtained as white solid;

Mp: 210-212 °C;

IR (KBr, ν_{max}cm^{-1}): 3293, 2932, 1772, 1725 and 1442;

^{1}H NMR ($CDCl_3$, 600 MHz): δ 8.20 (1H, d, *J*= 8.4 Hz), 7.97 (2H, m), 7.79 (1H, t, *J*= 7.8 Hz), 7.74 (1H, t, *J*=7.8 Hz), 7.49 (1H, d, *J*=7.2 Hz), 6.21 (1H, s), 4.91 (1H, t, *J*=8.4 Hz), 4.64 (1H, t, *J*=7.8 Hz), 4.47 (1H, s), 4.19 (1H, t, *J*=7.8 Hz), 4.02 (1H, t, *J*=9.0 Hz), 3.99 (1H, d, *J*=11.4 Hz), 3.64 (1H, dd, *J*=2.4, 11.4), 3.41 (1H, s), 3.39 (1H, m), 3.15 (1H, d, *J*=10.8 Hz), 2.65 (3H, m),

2.17 (1H, m), 1.90 (1H, m), 1.79 (2H, m), 1.73 (2H, m), 1.67 (4H, m), 1.60 (2H, m), 1.19 (1H, d, *J*=10.8 Hz), 1.15 (3H, s), 1.02 (2H, m), 0.97 (1H, m), 0.75 (1H, m), 0.21 (3H, s);

^{13}C NMR ($CDCl_3$, 150 MHz): 14.4 (-CH_3), 19.7 (-CH_2), 22.6 (-CH_3), 24.0 (-CH_2), 25.1 (-CH_2), 28.1 (-CH_2), 28.6 (-CH_2), 36.8 (-CH_2), 37.7 (-CH_2), 39.2 (-C), 42.8 (-C), 47.7 (-CH), 49.1 (-CH_2), 52.8 (-CH), 55.1 (-CH), 56.3 (-C), 64.0 (-CH_2), 65.3 (-CH), 67.2 (-CH), 69.3 (-CH_2), 79.2 (-C), 80.4 (-CH), 106.6 (-CH_2), 122.7 (-CH), 122.8 (-CH), 125.7 (-CH), 128.4 (-CH), 128.5 (-CH), 130.7 (-C), 131.3 (-C), 132.7 (-CH), 137.1 (-C), 143.0 (-C), 146.3 (-C), 177.8 (-C=O), 209.7 (-C=O);

MS [ESI-MS, positive mode]: m/z 586$[M+H]^+$, 608$[M+Na]^+$;

HRMS [ESI-MS, positive mode]: MF: $C_{42}H_{48}N_2O_6$; 586.3140 $[M+H]^+$ [calcd. 586.3169].

Abbreviation:

MTT: 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide

CHO: Chinese Hamster Ovarian carcinoma cell

HepG2: Human hepatocellular carcinoma cell

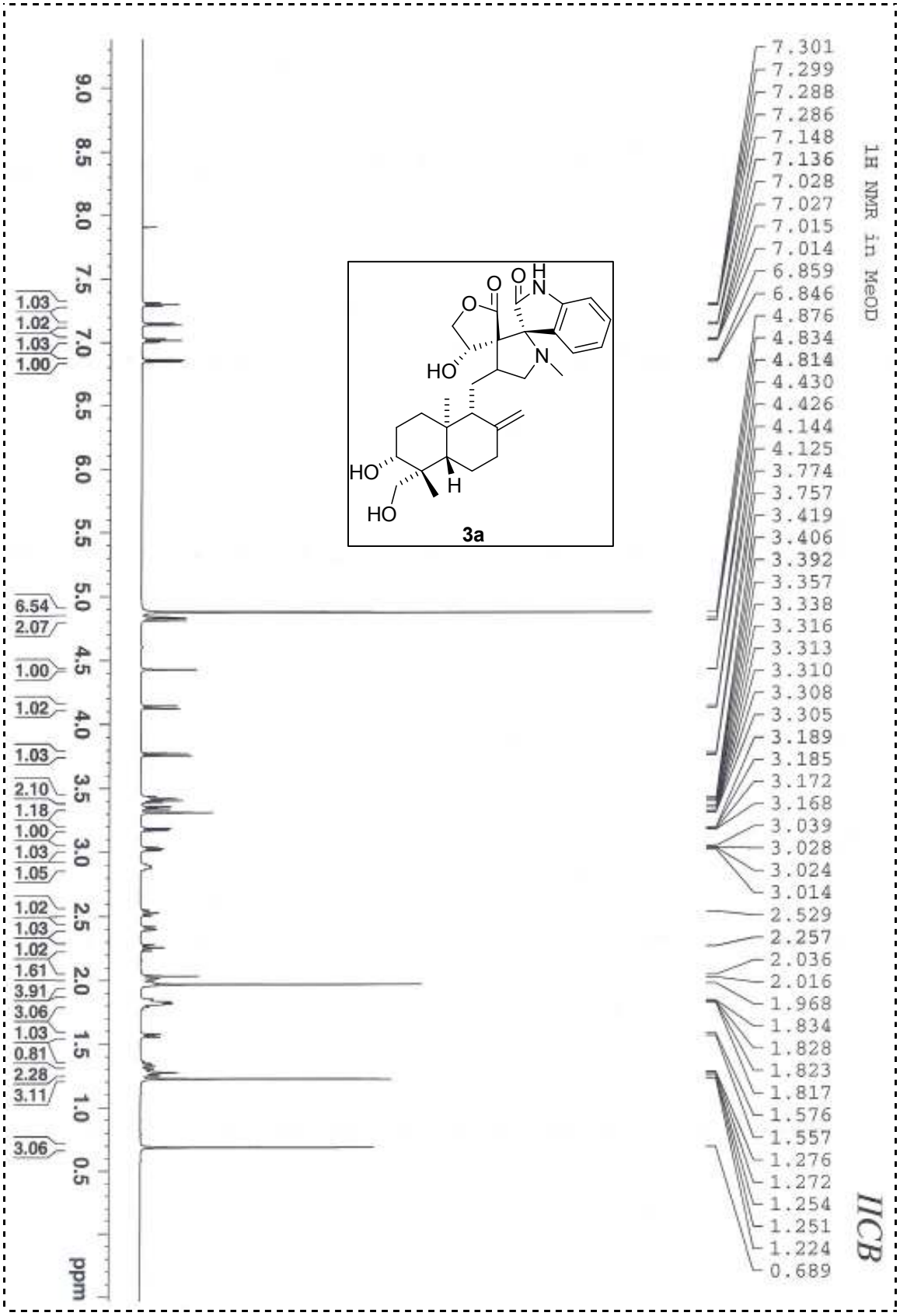
HeLa: Human leukemia cell

A-431 : Human epidermoid carcinoma cell

MCF-7: Human breast carcinoma cell

MDCK: Madin-Darby Canine Kidney carcinoma cell

Caco-2: Human epithelial colorectal adenocarcinoma cell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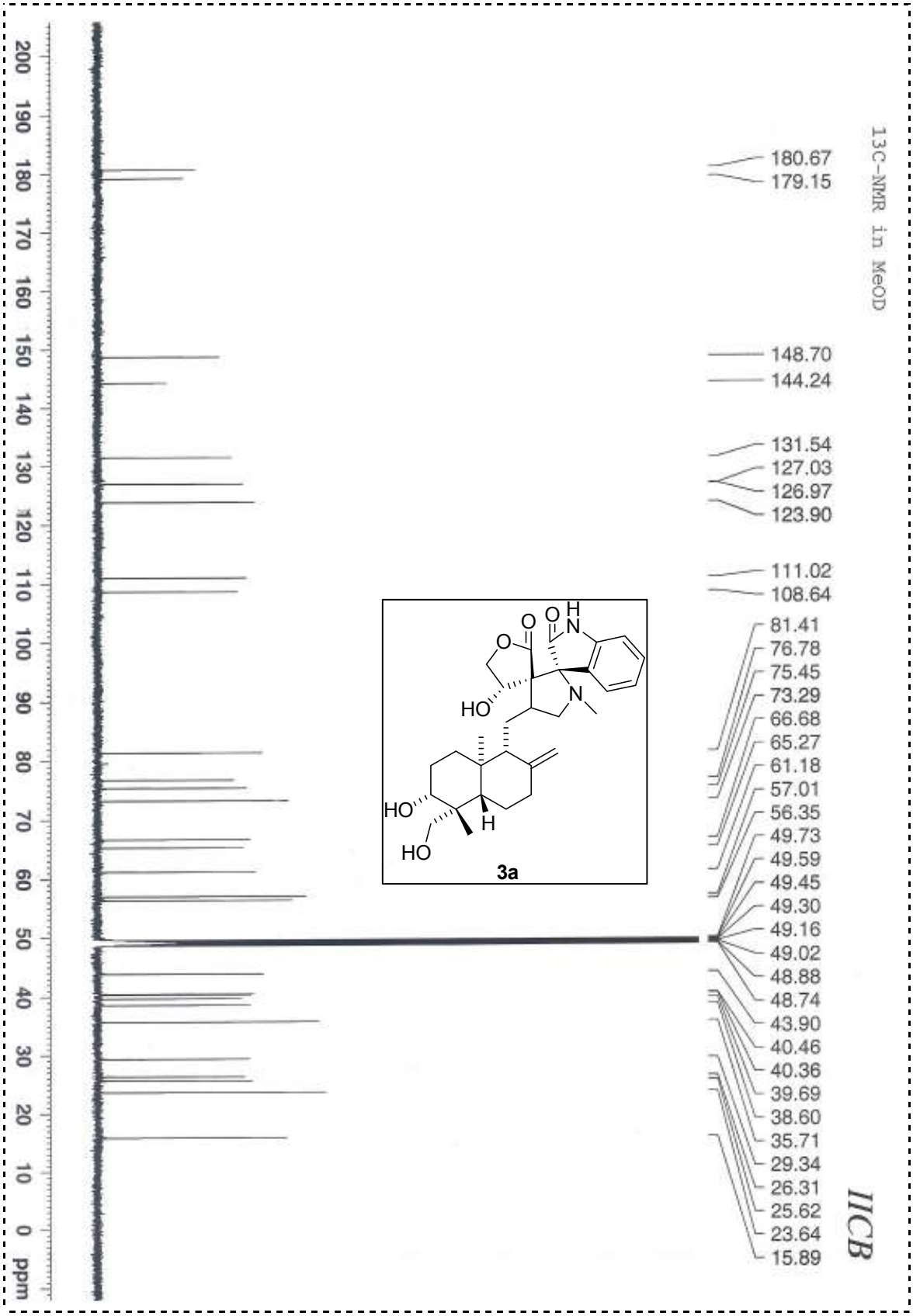
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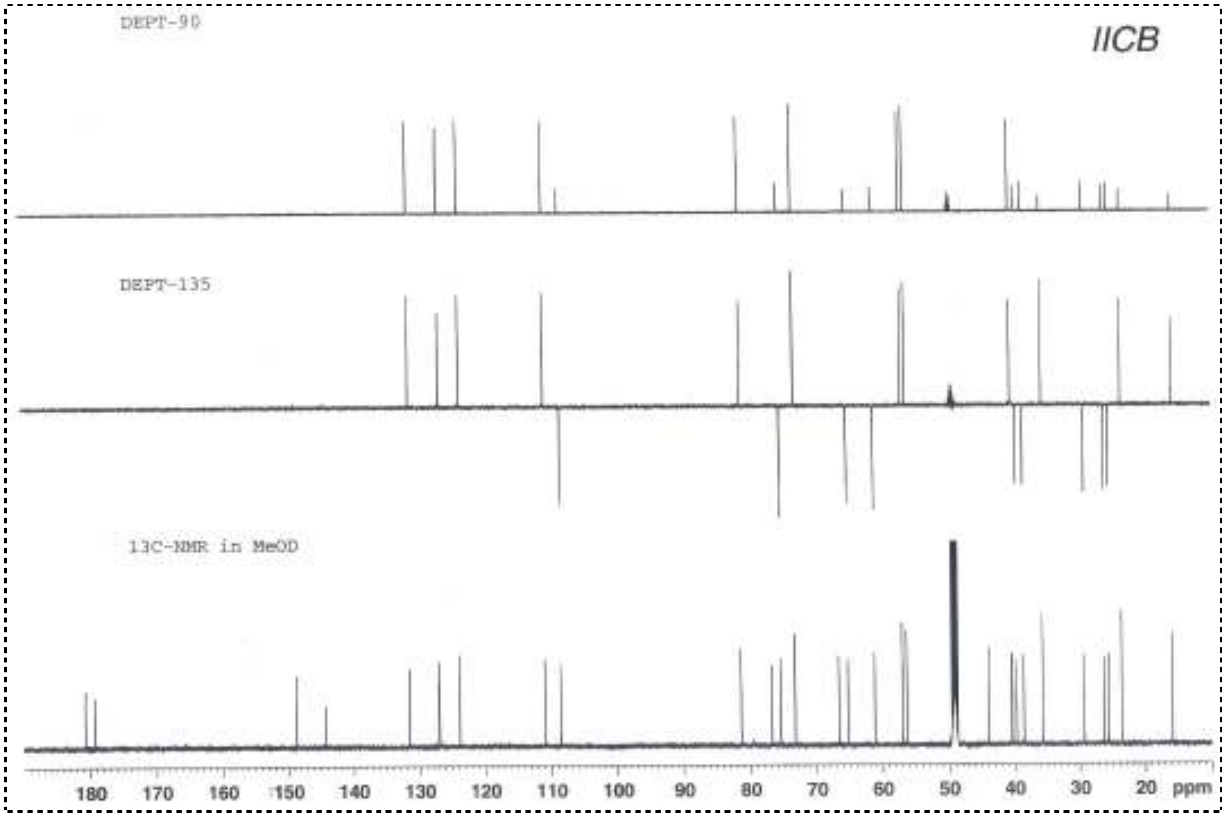
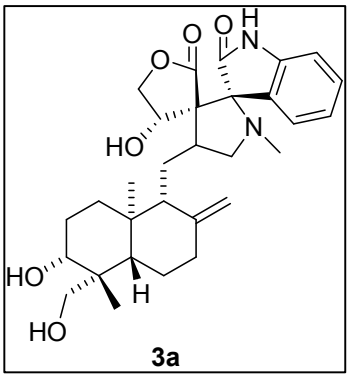
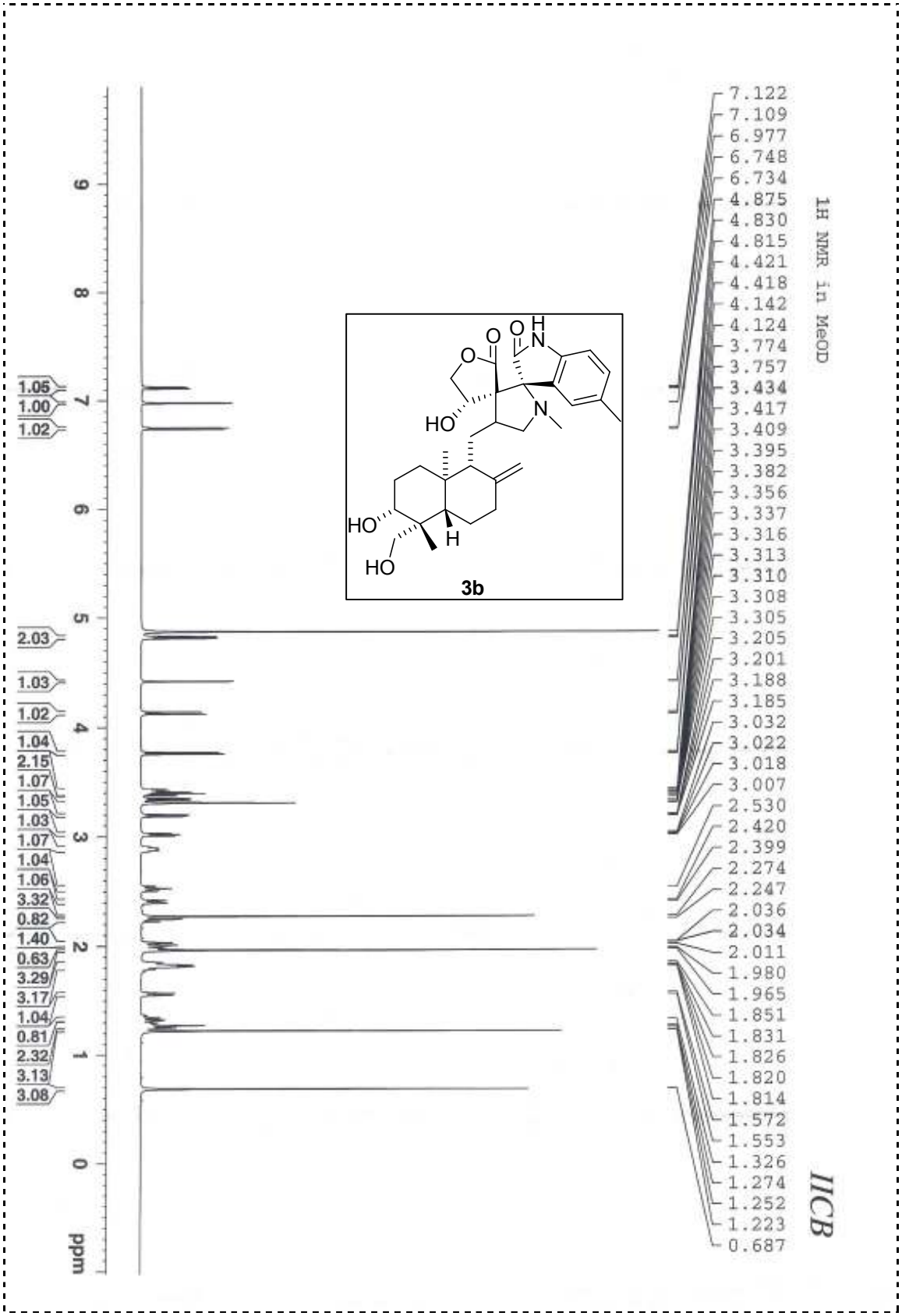
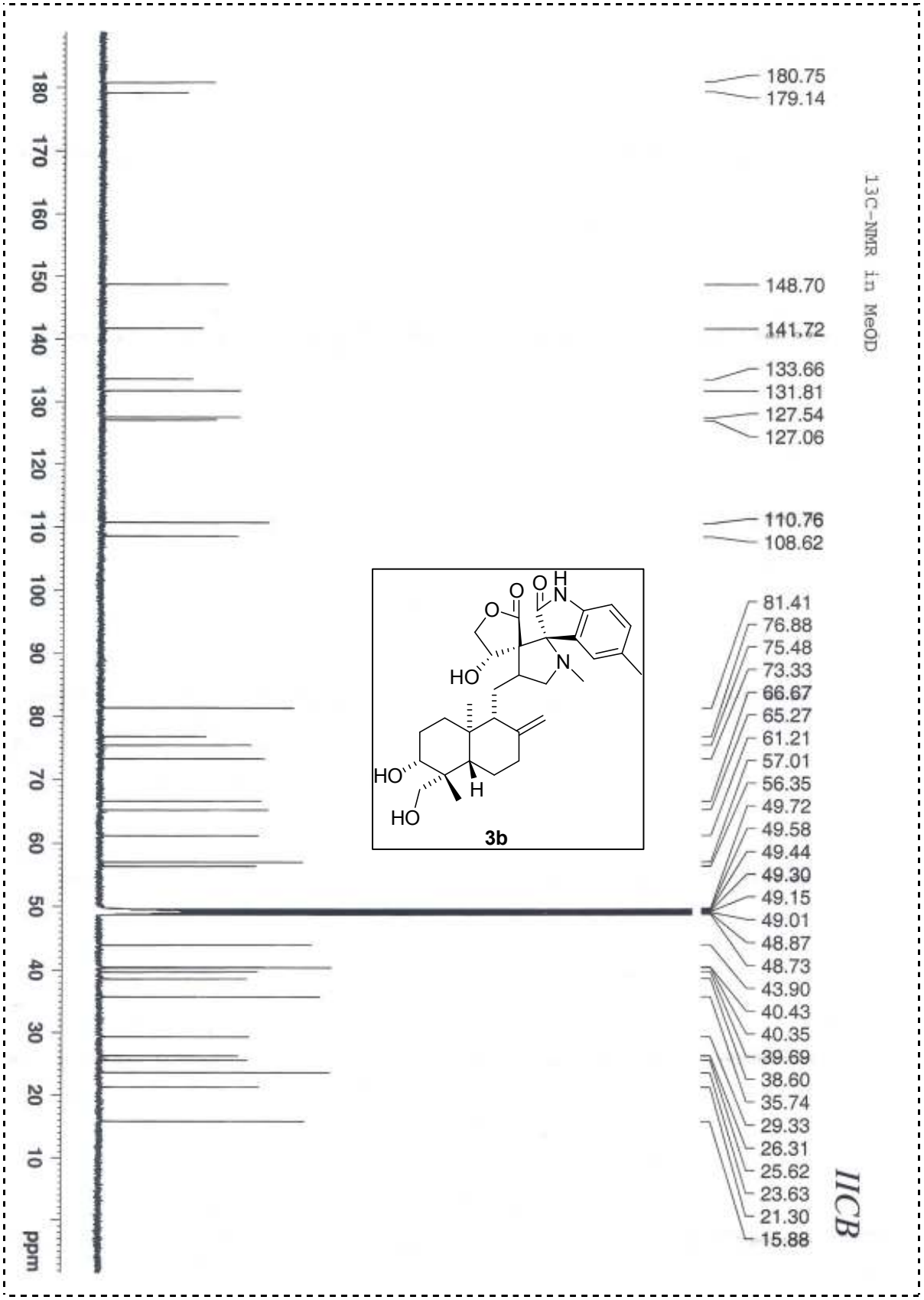
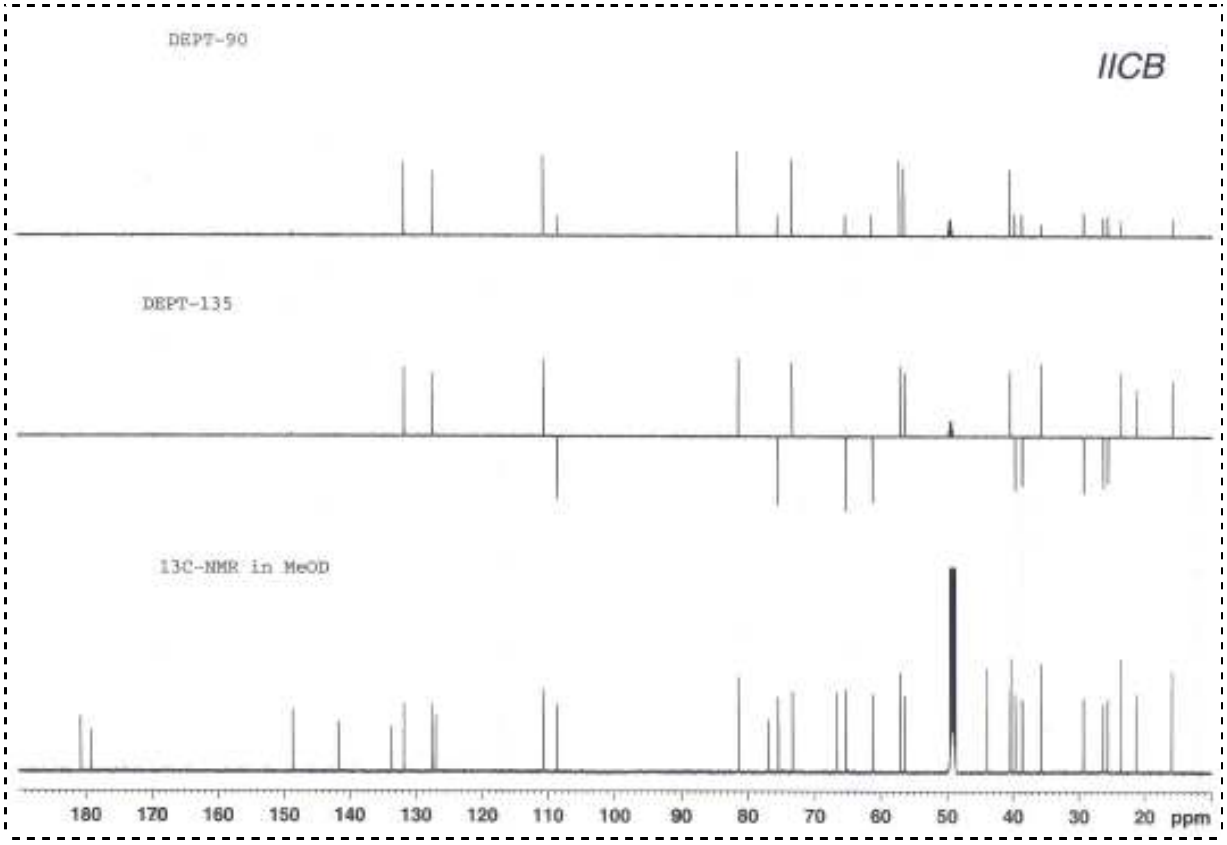
127.03
126.97
123.90
111.02
108.64
81.41
76.78
75.45
73.29
66.68
65.27
61.18
57.01
56.35
49.73
49.59
49.45
49.30
49.16
49.02
48.88
48.74
43.90
40.46
40.36
39.69
38.60
35.71
29.34
26.31
25.62
23.64
15.89
IICB
3a
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

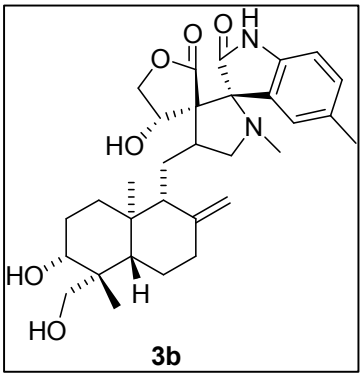

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

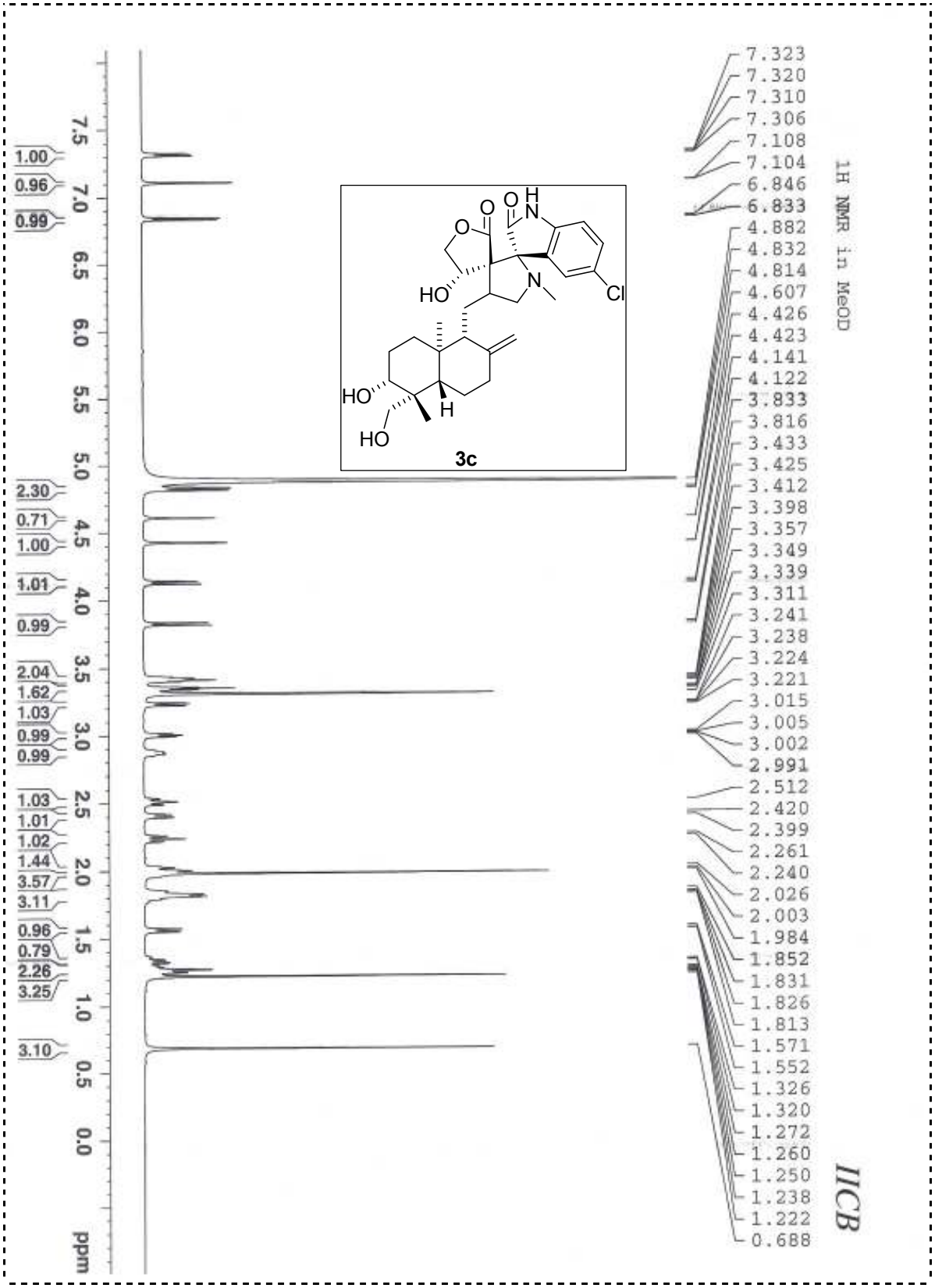

O
O
O
H
N
N
HO
HO
H
HO
3a

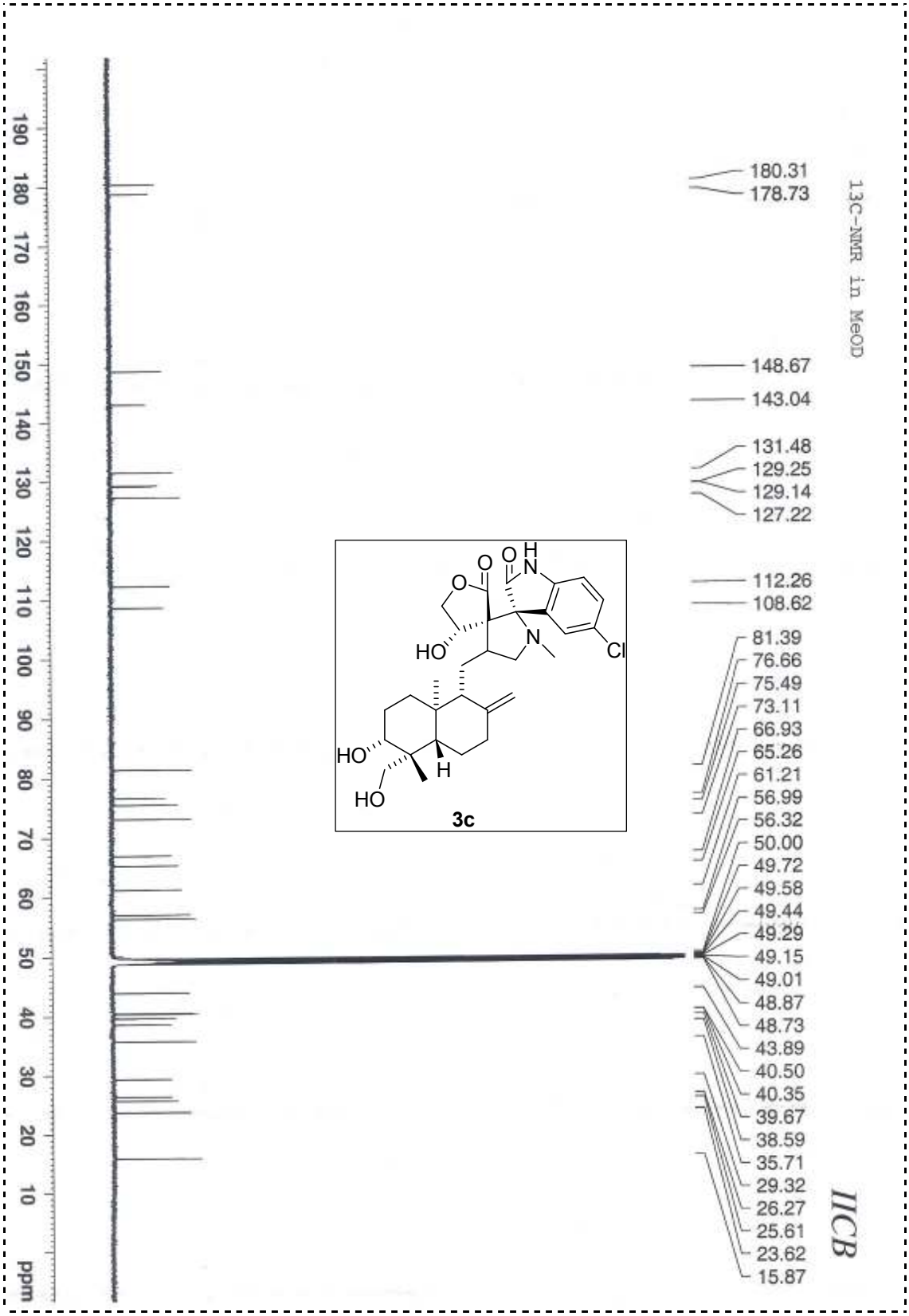

1H NMR in MeOD
7.122
7.109
6.977
6.748
6.734
4.875
4.830
4.815
4.421
4.418
4.142
4.124
3.774
3.757
3.434
3.417
3.409
3.395
3.382
3.356
3.337
3.316
3.313
3.310
3.308
3.305
3.205
3.201
3.188
3.185
3.032
3.022
3.018
3.007
2.530
2.420
2.399
2.274
2.247
2.036
2.034
2.011
1.980
1.965
1.851
1.831
1.826
1.820
1.814
1.572
1.553
1.326
1.274
1.252
1.223
0.687
IICB
1.05
1.00
1.02
2.03
1.03
1.02
1.04
2.15
1.07
1.05
1.03
1.07
1.04
1.06
3.32
0.82
1.40
0.63
3.29
3.17
1.04
0.81
2.32
3.13
3.08
ppm
HO
HO
HO
H
O
O
O
H
N
N
3b

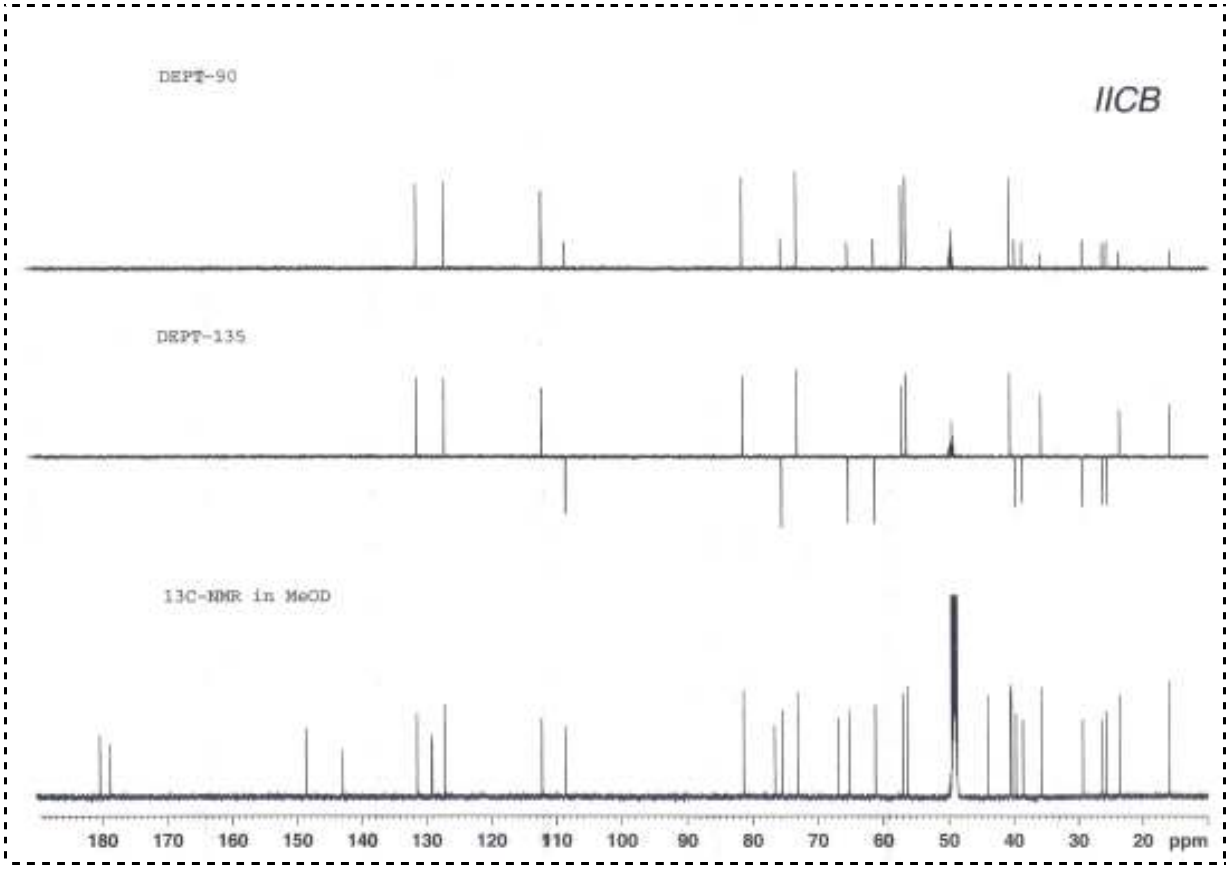

13C-NMR in MeOD
180.75
179.14
148.70
141.72
133.66
131.81
127.54
127.06
110.76
108.62
81.41
76.88
75.48
73.33
66.67
65.27
61.21
57.01
56.35
49.72
49.58
49.44
49.30
49.15
49.01
48.87
48.73
43.90
40.43
40.35
39.69
38.60
35.74
29.33
26.31
25.62
23.63
21.30
15.88
IICB
ppm
3b

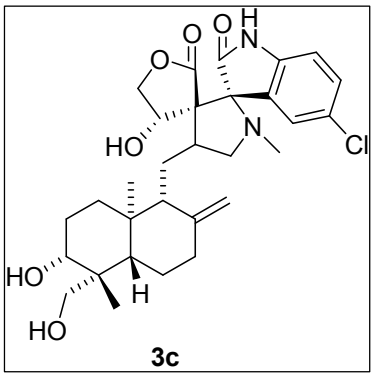

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
O
H
N
N
HO
HO
H
HO
3b

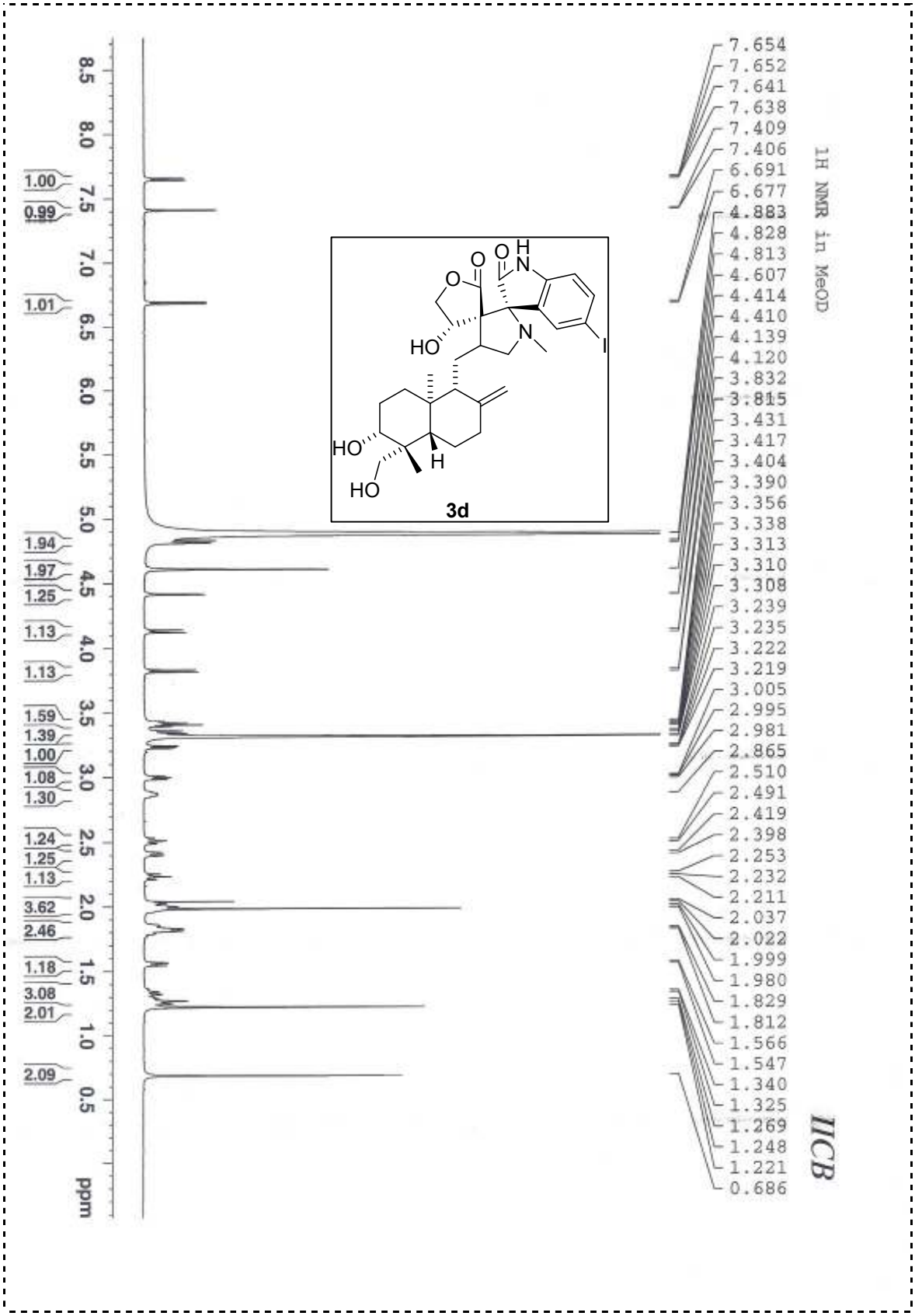

1H NMR in MeOD
IICB
7.323
7.320
7.310
7.306
7.108
7.104
6.846
6.833
4.882
4.832
4.814
4.607
4.426
4.423
4.141
4.122
3.833
3.816
3.433
3.425
3.412
3.398
3.357
3.349
3.339
3.311
3.241
3.238
3.224
3.221
3.015
3.005
3.002
2.991
2.512
2.420
2.399
2.261
2.240
2.026
2.003
1.984
1.852
1.831
1.826
1.813
1.571
1.552
1.326
1.320
1.272
1.260
1.250
1.238
1.222
0.688
1.00
0.96
0.99
2.30
0.71
1.00
1.01
0.99
2.04
1.62
1.03
0.99
0.99
1.03
1.01
1.02
1.44
3.57
3.11
0.96
0.79
2.26
3.25
3.10
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
O
O
H
N
O
HO
N
Cl
HO
H
HO
3c

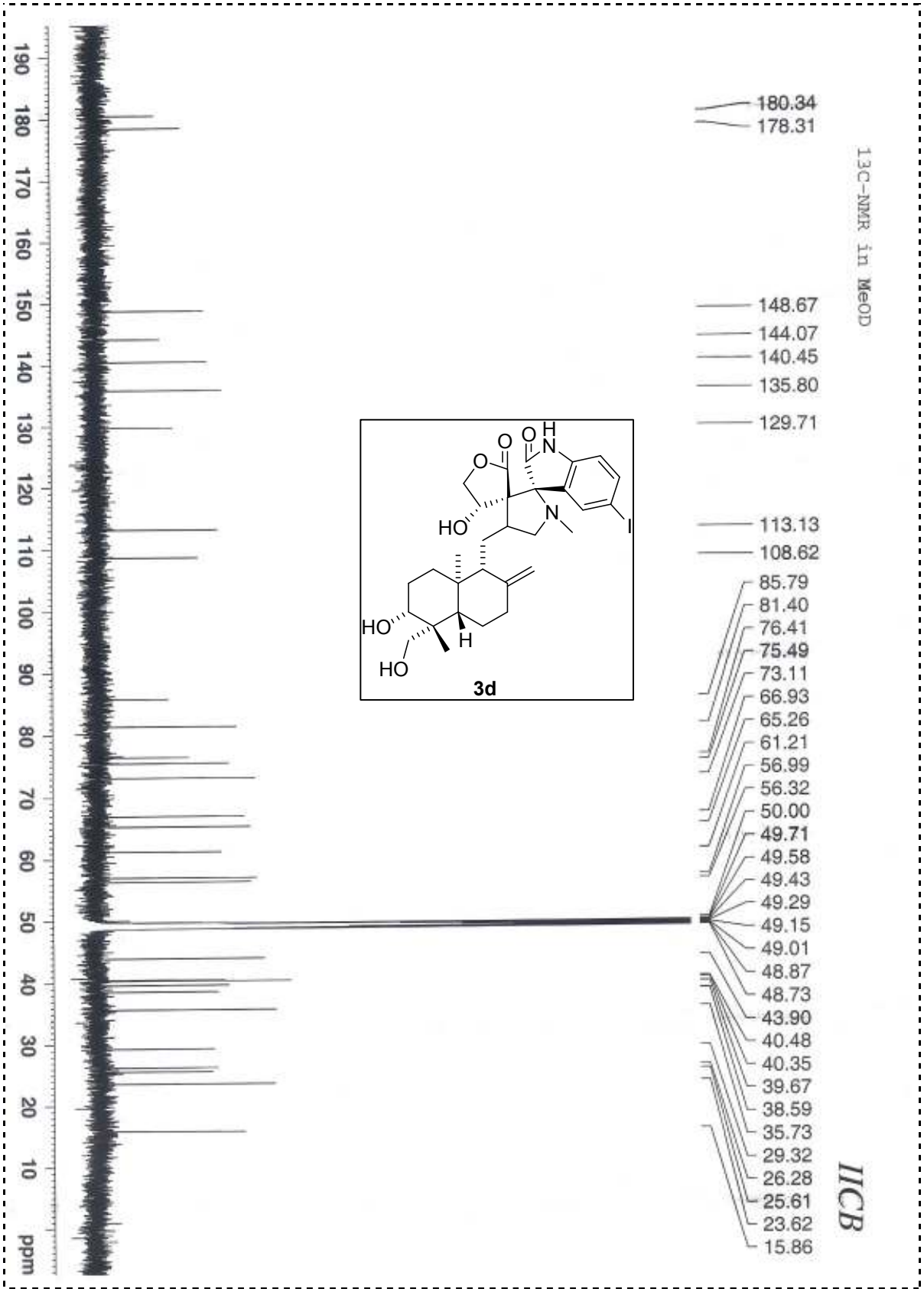

13C-NMR in MeOD
180.31
178.73
148.67
143.04
131.48
129.25
129.14
127.22
112.26
108.62
81.39
76.66
75.49
73.11
66.93
65.26
61.21
56.99
56.32
50.00
49.72
49.58
49.44
49.29
49.15
49.01
48.87
48.73
43.89
40.50
40.35
39.67
38.59
35.71
29.32
26.27
25.61
23.62
15.87
IICB
3c
ppm

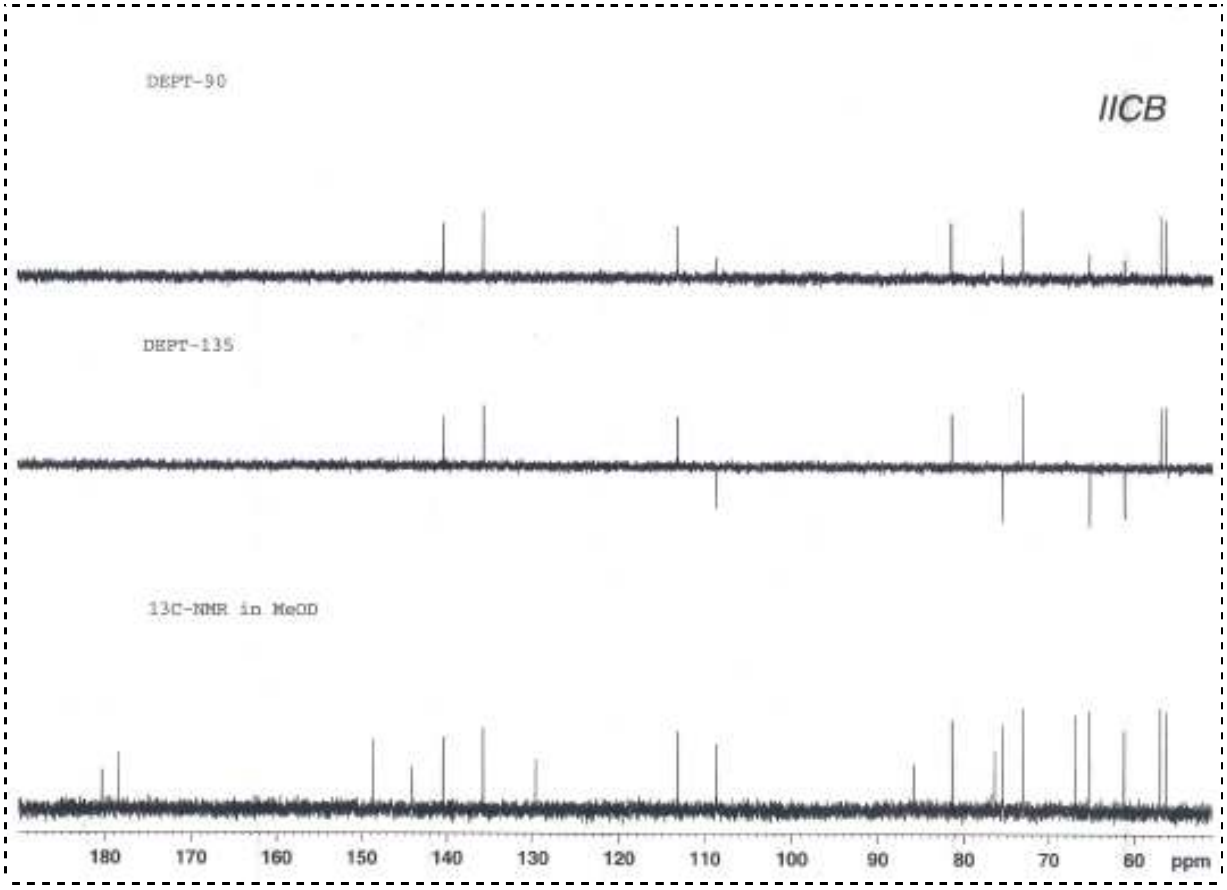

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

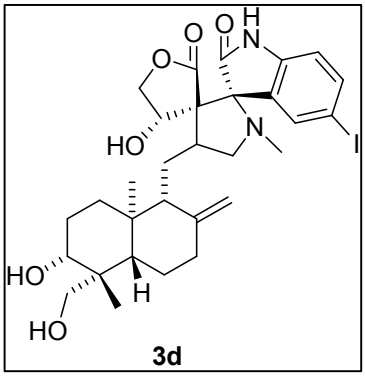

O
O
O
H
N
N
HO
Cl
HO
H
HO

3c

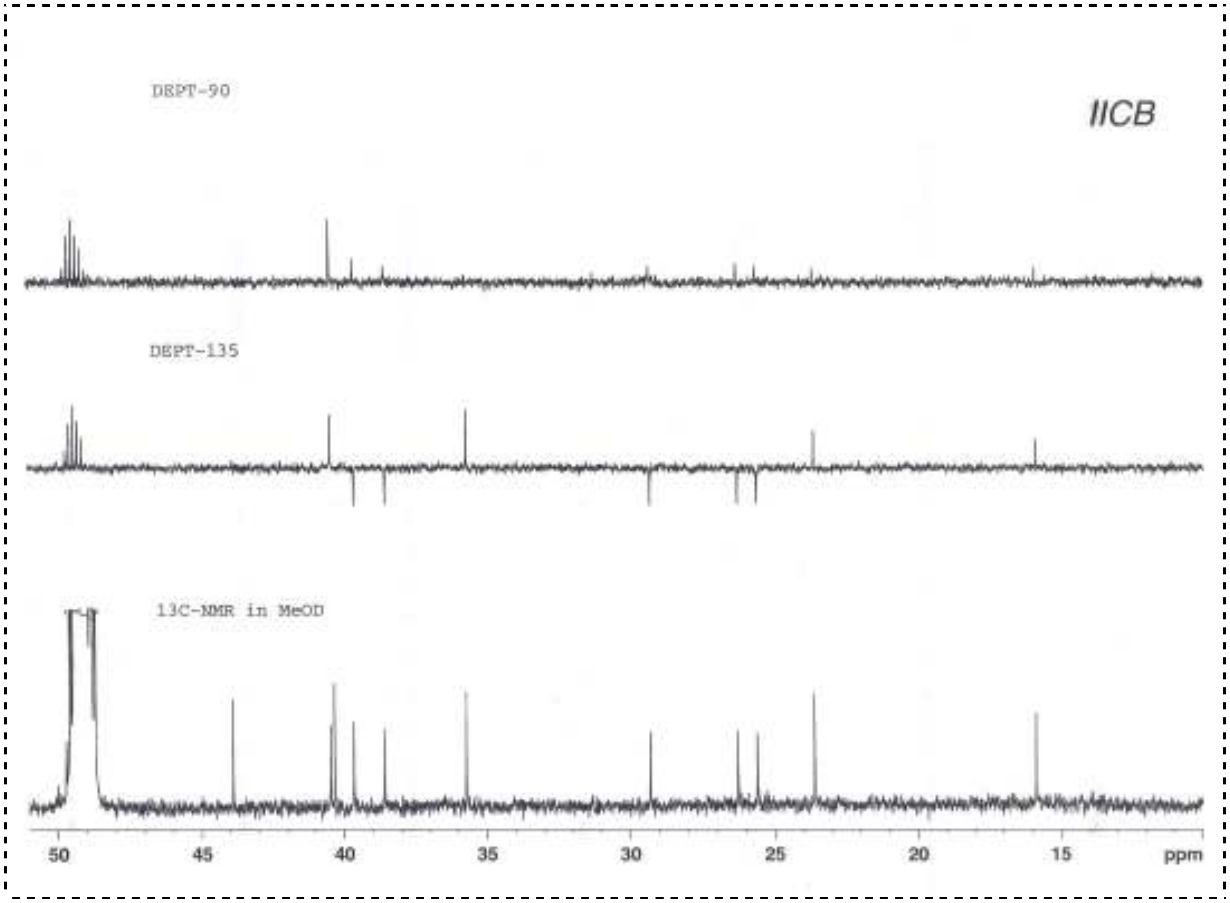

1H NMR in MeOD
7.654
7.652
7.641
7.638
7.409
7.406
6.691
6.677
4.883
4.828
4.813
4.607
4.414
4.410
4.139
4.120
3.832
3.815
3.431
3.417
3.404
3.390
3.356
3.338
3.313
3.310
3.308
3.239
3.235
3.222
3.219
3.005
2.995
2.981
2.865
2.510
2.491
2.419
2.398
2.253
2.232
2.211
2.037
2.022
1.999
1.980
1.829
1.812
1.566
1.547
1.340
1.325
1.269
1.248
1.221
0.686
1.00
0.99
1.01
1.94
1.97
1.25
1.13
1.13
1.59
1.39
1.00
1.08
1.30
1.24
1.25
1.13
3.62
2.46
1.18
3.08
2.01
2.09
ppm
HO
O
O
H
N
N
I
HO
H
HO
3d
IICB

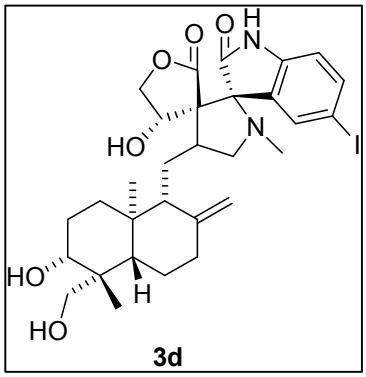

13C-NMR in MeOD
180.34
178.31
148.67
144.07
140.45
135.80
129.71
113.13
108.62
85.79
81.40
76.41
75.49
73.11
66.93
65.26
61.21
56.99
56.32
50.00
49.71
49.58
49.43
49.29
49.15
49.01
48.87
48.73
43.90
40.48
40.35
39.67
38.59
35.73
29.32
26.28
25.61
23.62
15.86
IICB
ppm
3d

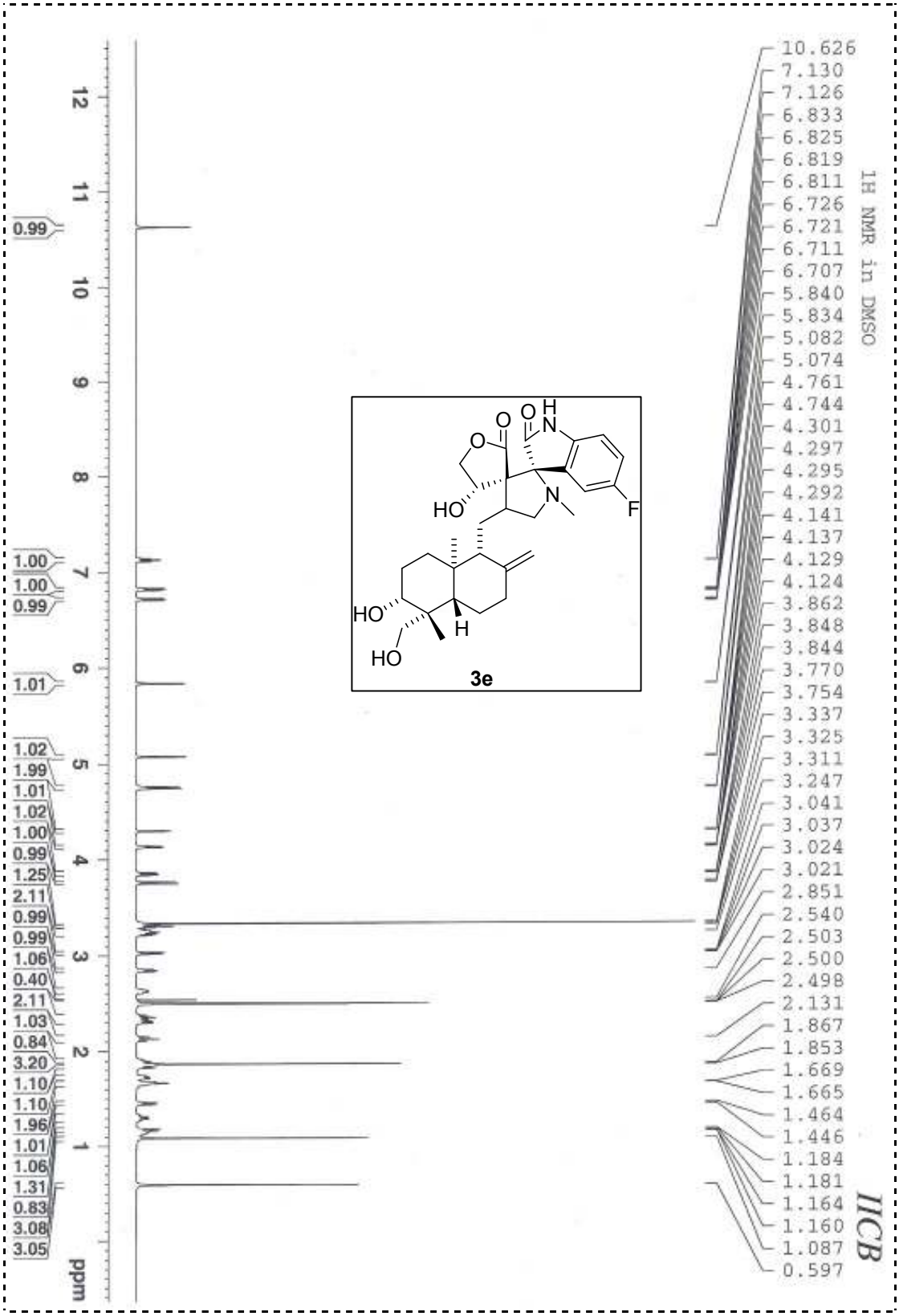

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180
170
160
150
140
130
120
110
100
90
80
70
60
ppm


O
O
H
N
O
HO
N
I
HO
H
HO

3d


DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
50
45
40
35
30
25
20
15
ppm


O
O
H
N
O
HO
N
I
HO
H
HO
3d


1H NMR in DMSO
IICB
3e
HO
HO
HO
H
O
O
O
H
N
N
F
ppm
12
11
10
9
8
7
6
5
4
3
2
1
0.99
1.00
1.00
0.99
1.01
1.02
1.99
1.01
1.02
1.00
0.99
1.25
2.11
0.99
0.99
1.06
0.40
2.11
1.03
0.84
3.20
1.10
1.10
1.96
1.01
1.06
1.31
0.83
3.08
3.05
10.626
7.130
7.126
6.833
6.825
6.819
6.811
6.726
6.721
6.711
6.707
5.840
5.834
5.082
5.074
4.761
4.744
4.301
4.297
4.295
4.292
4.141
4.137
4.129
4.124
3.862
3.848
3.844
3.770
3.754
3.337
3.325
3.311
3.247
3.041
3.037
3.024
3.021
2.851
2.540
2.503
2.500
2.498
2.131
1.867
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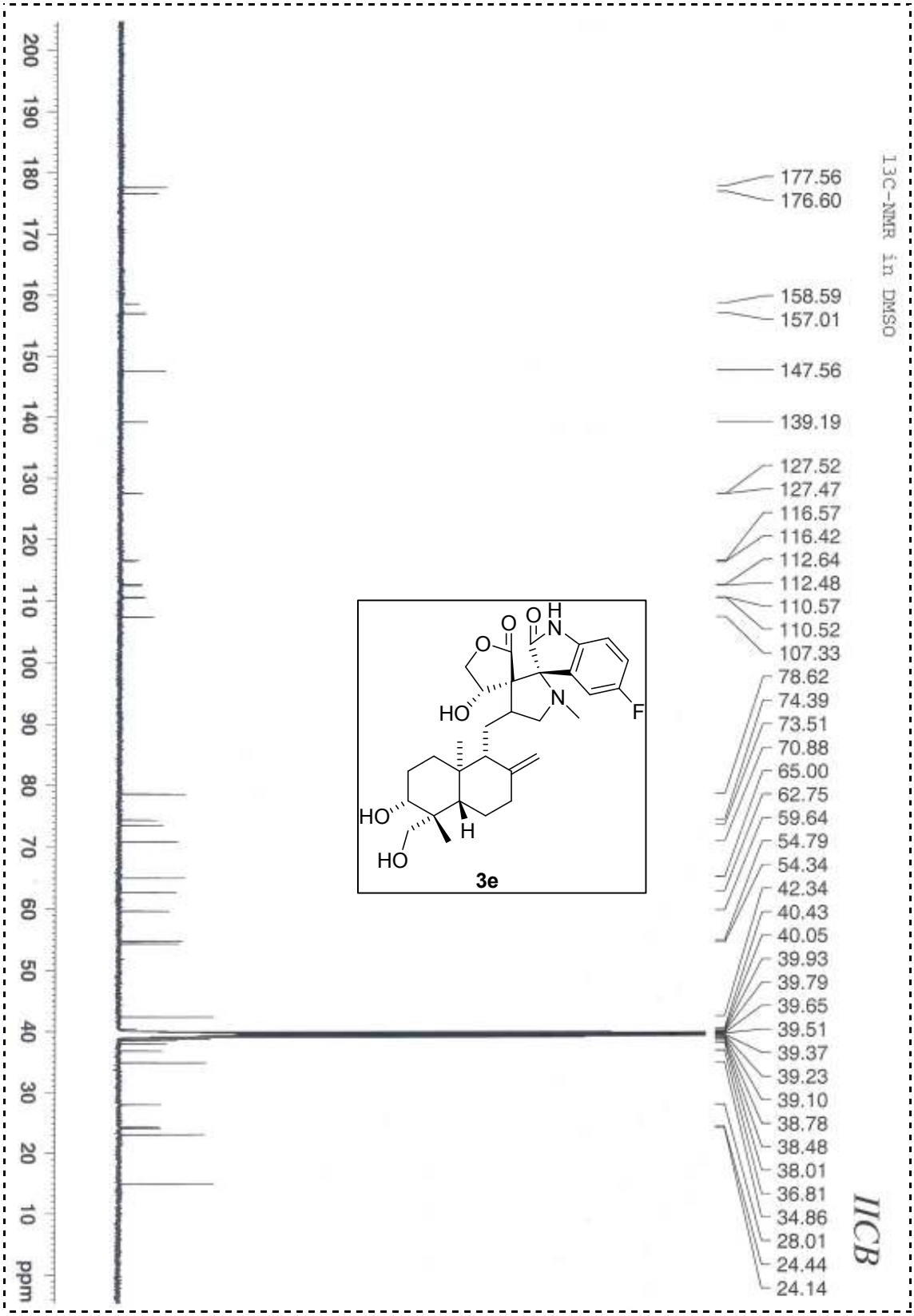
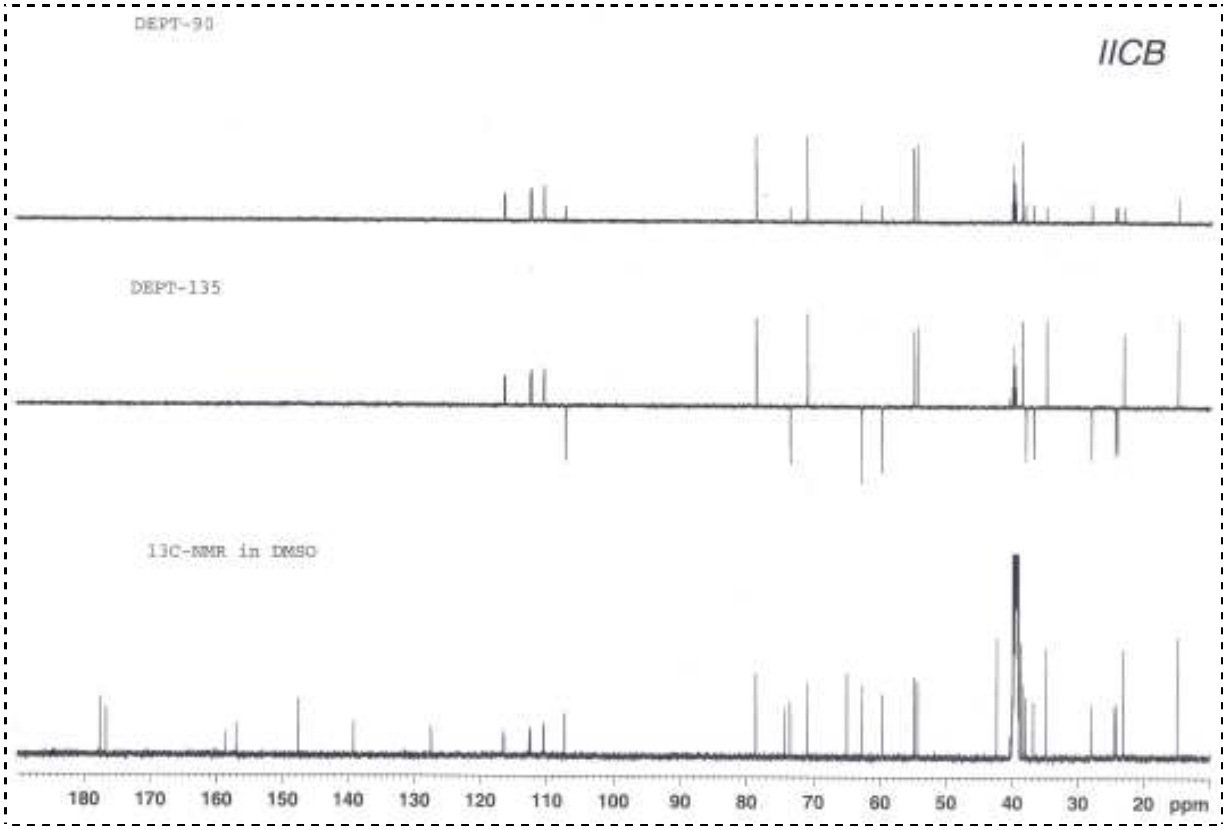
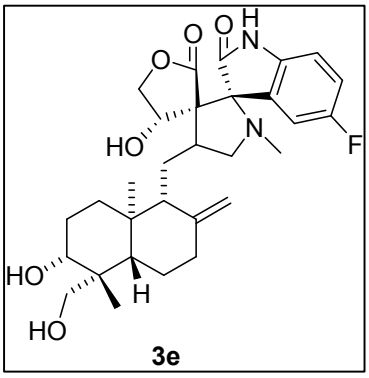
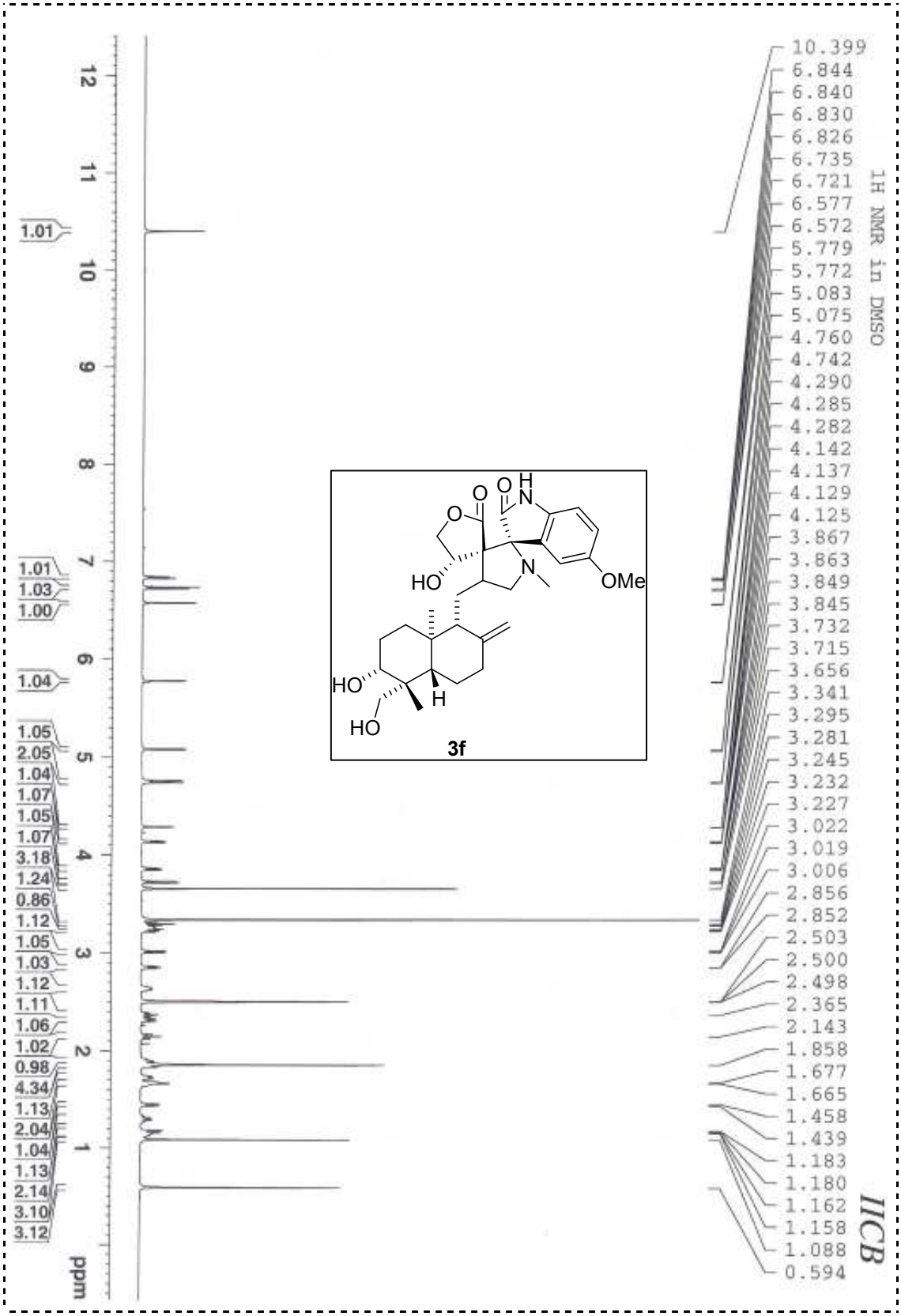
1.665
1.464
1.446
1.184
1.181
1.164
1.160
1.087
0.597

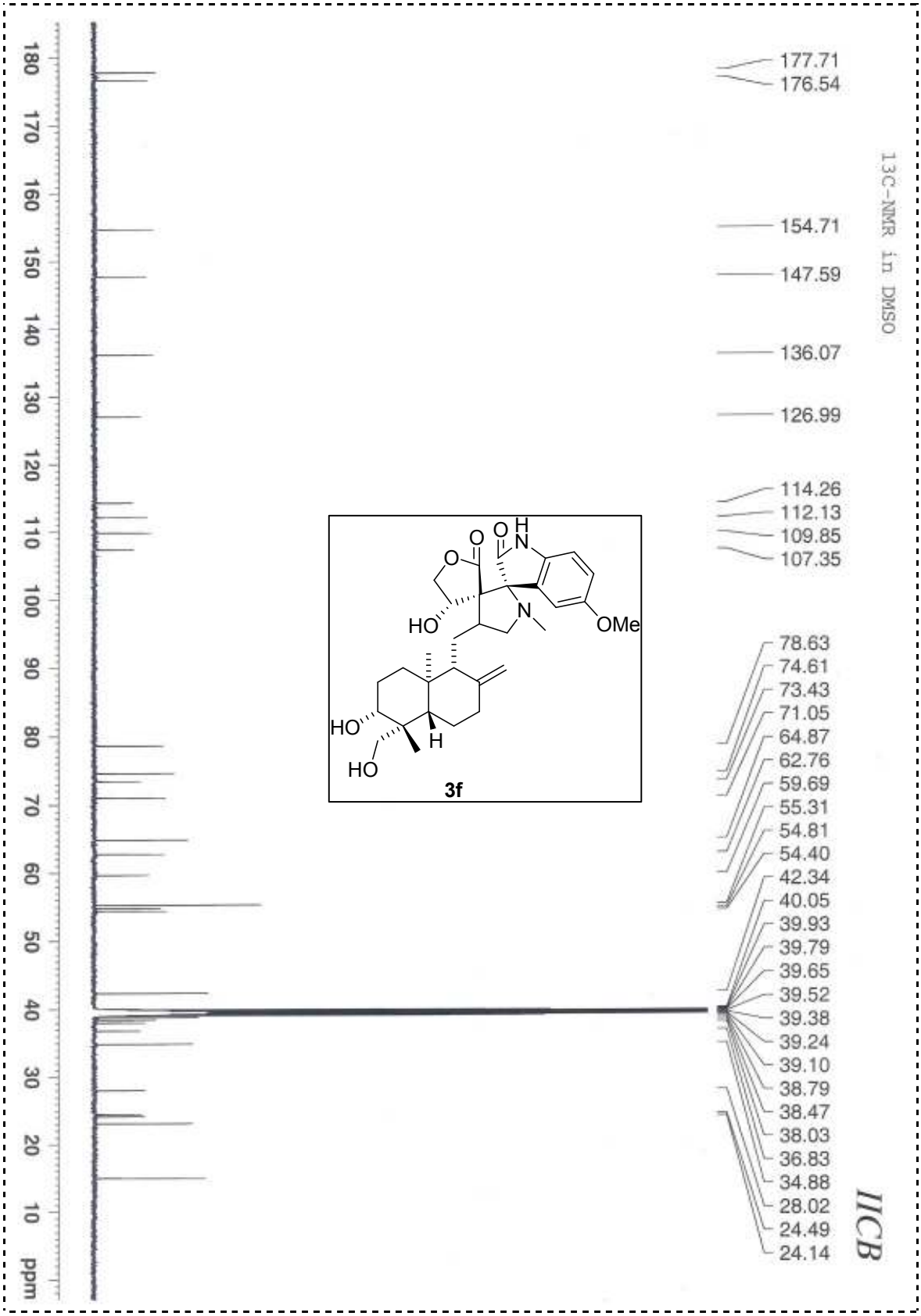

13C-NMR in DMSO
177.56
176.60
158.59
157.01
147.56
139.19
127.52
127.47
116.57
116.42
112.64
112.48
110.57
110.52
107.33
78.62
74.39
73.51
70.88
65.00
62.75
59.64
54.79
54.34
42.34
40.43
40.05
39.93
39.79
39.65
39.51
39.37
39.23
39.10
38.78
38.48
38.01
36.81
34.86
28.01
24.44
24.14
IICB
3e
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

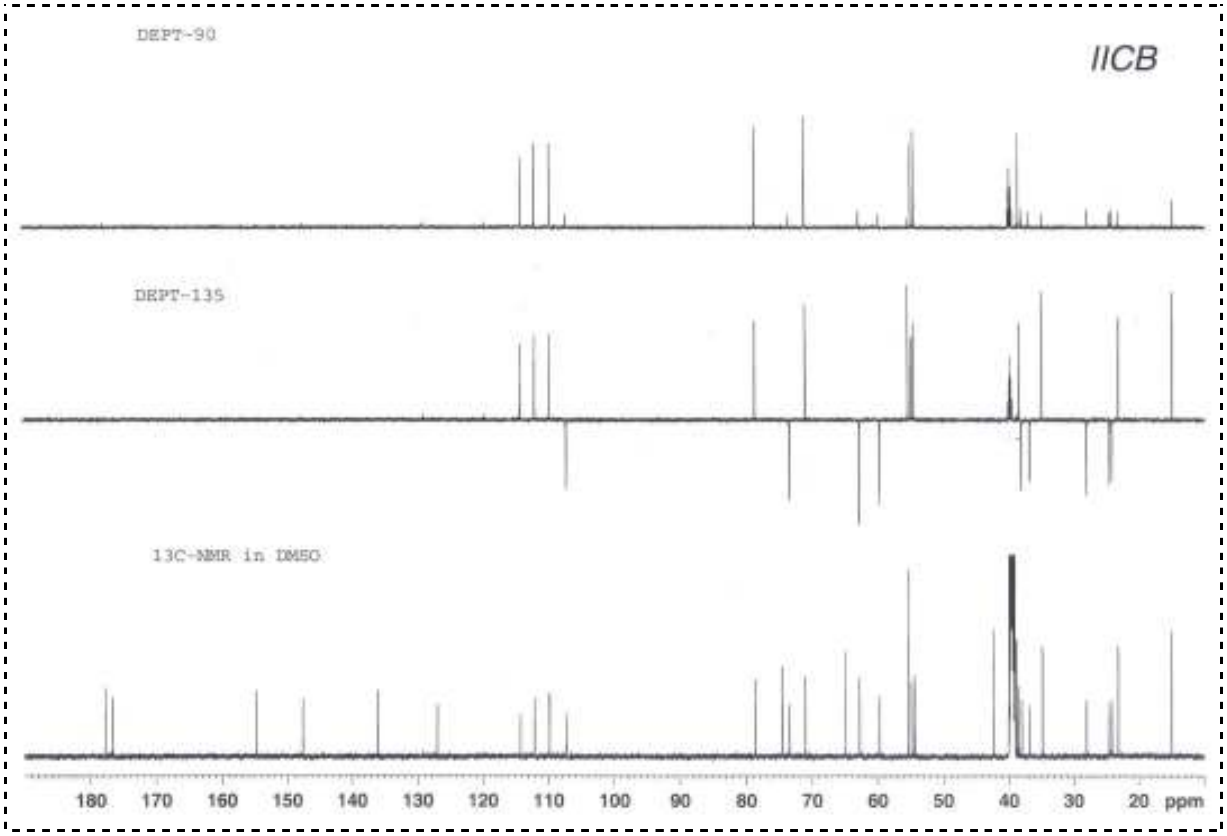

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

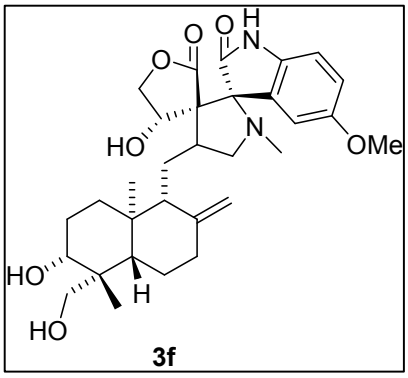

O
O
H
N
O
N
F
HO
HO
H
HO

3e

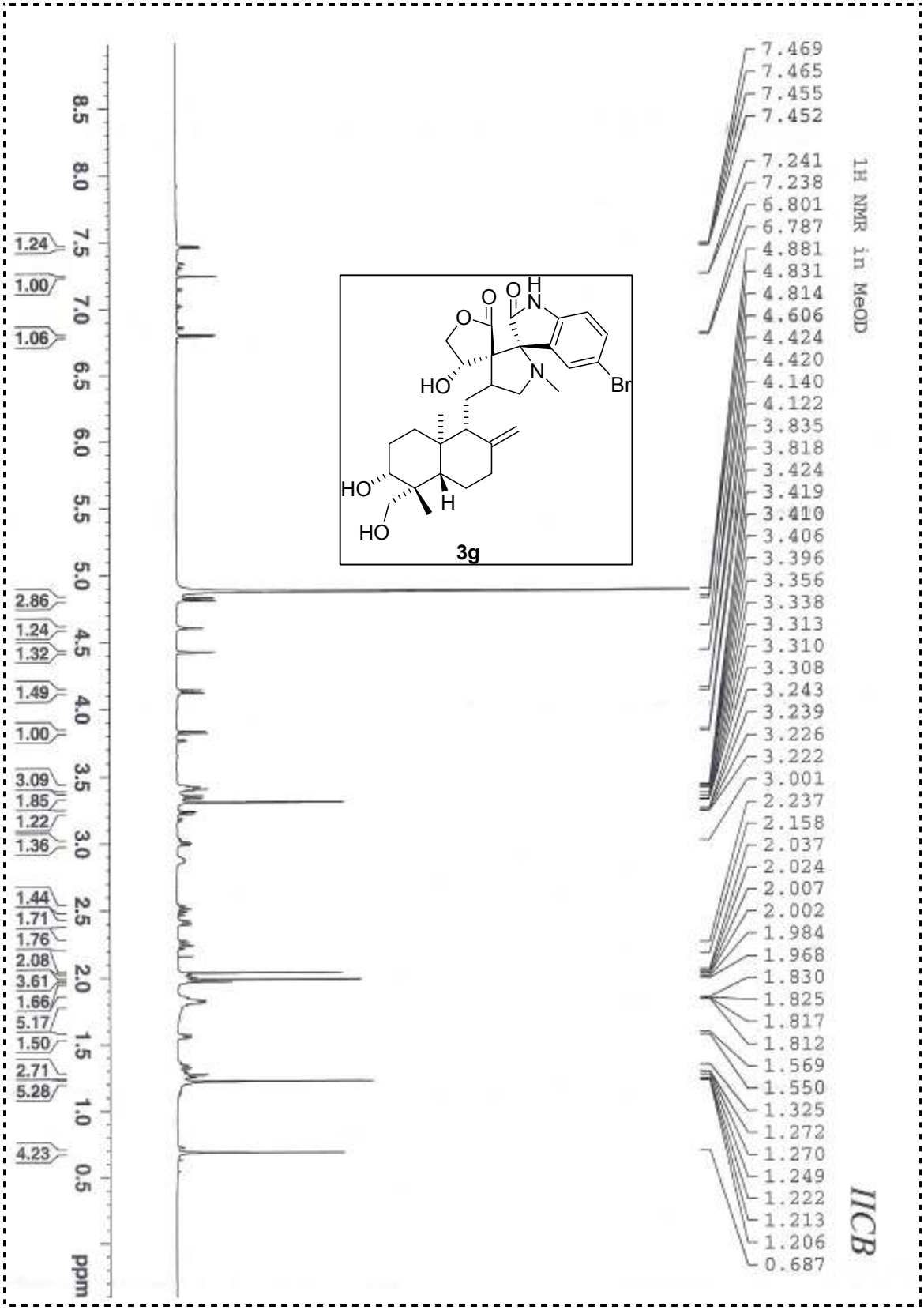

1H NMR in DMSO
10.399
6.844
6.840
6.830
6.826
6.735
6.721
6.577
6.572
5.779
5.772
5.083
5.075
4.760
4.742
4.290
4.285
4.282
4.142
4.137
4.129
4.125
3.867
3.863
3.849
3.845
3.732
3.715
3.656
3.341
3.295
3.281
3.245
3.232
3.227
3.022
3.019
3.006
2.856
2.852
2.503
2.500
2.498
2.365
2.143
1.858
1.677
1.665
1.458
1.439
1.183
1.180
1.162
1.158
1.088
0.594
IICB
ppm
12
11
10
9
8
7
6
5
4
3
2
1
1.01
1.01
1.03
1.00
1.04
1.05
2.05
1.04
1.07
1.05
1.07
3.18
1.24
0.86
1.12
1.05
1.03
1.12
1.11
1.06
1.02
0.98
4.34
1.13
2.04
1.04
1.13
2.14
3.10
3.12
O
O
O
H
N
HO
N
OMe
HO
H
HO
3f

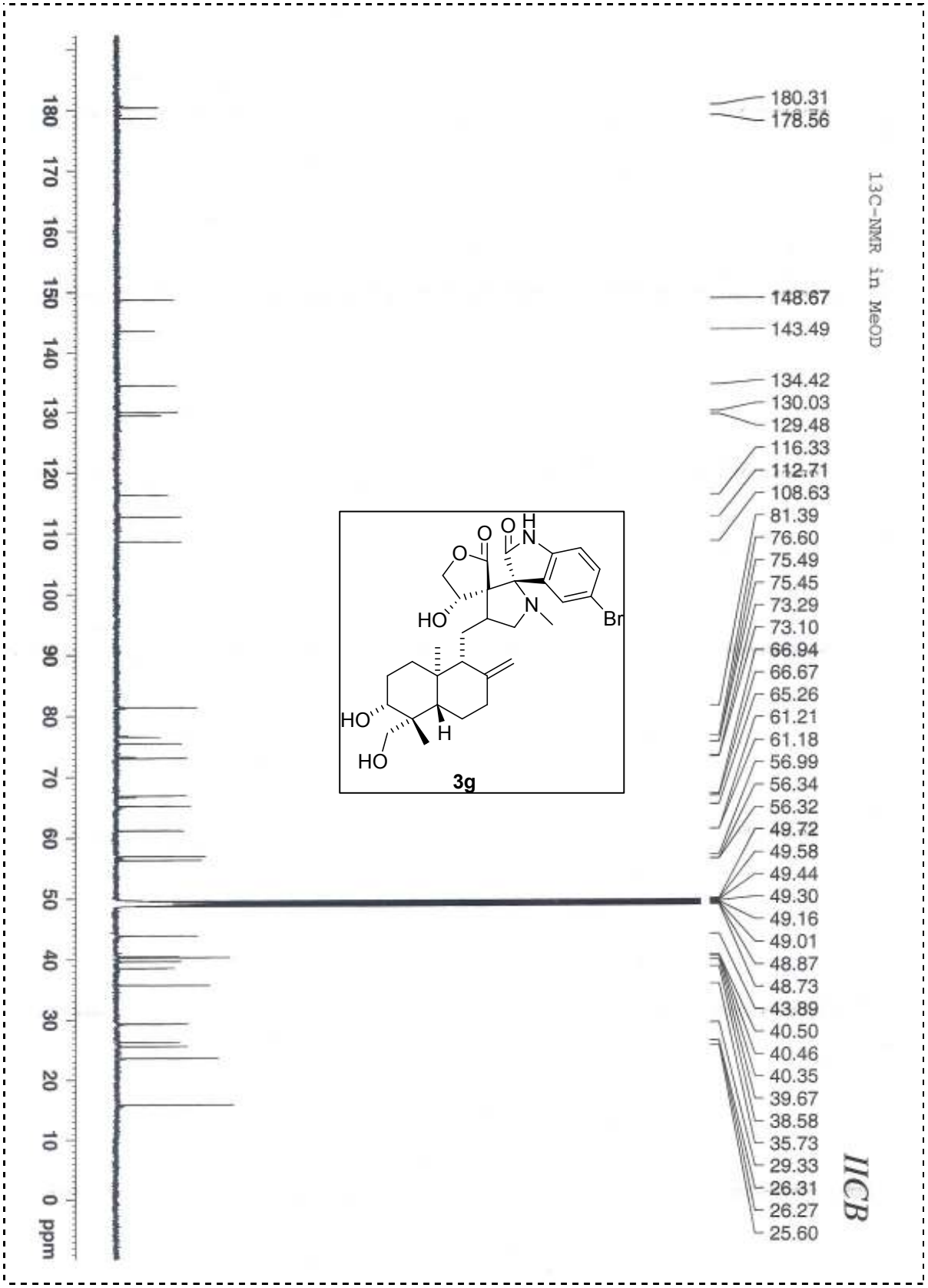

13C-NMR in DMSO
177.71
176.54
154.71
147.59
136.07
126.99
114.26
112.13
109.85
107.35
78.63
74.61
73.43
71.05
64.87
62.76
59.69
55.31
54.81
54.40
42.34
40.05
39.93
39.79
39.65
39.52
39.38
39.24
39.10
38.79
38.47
38.03
36.83
34.88
28.02
24.49
24.14
3f
IICB
ppm

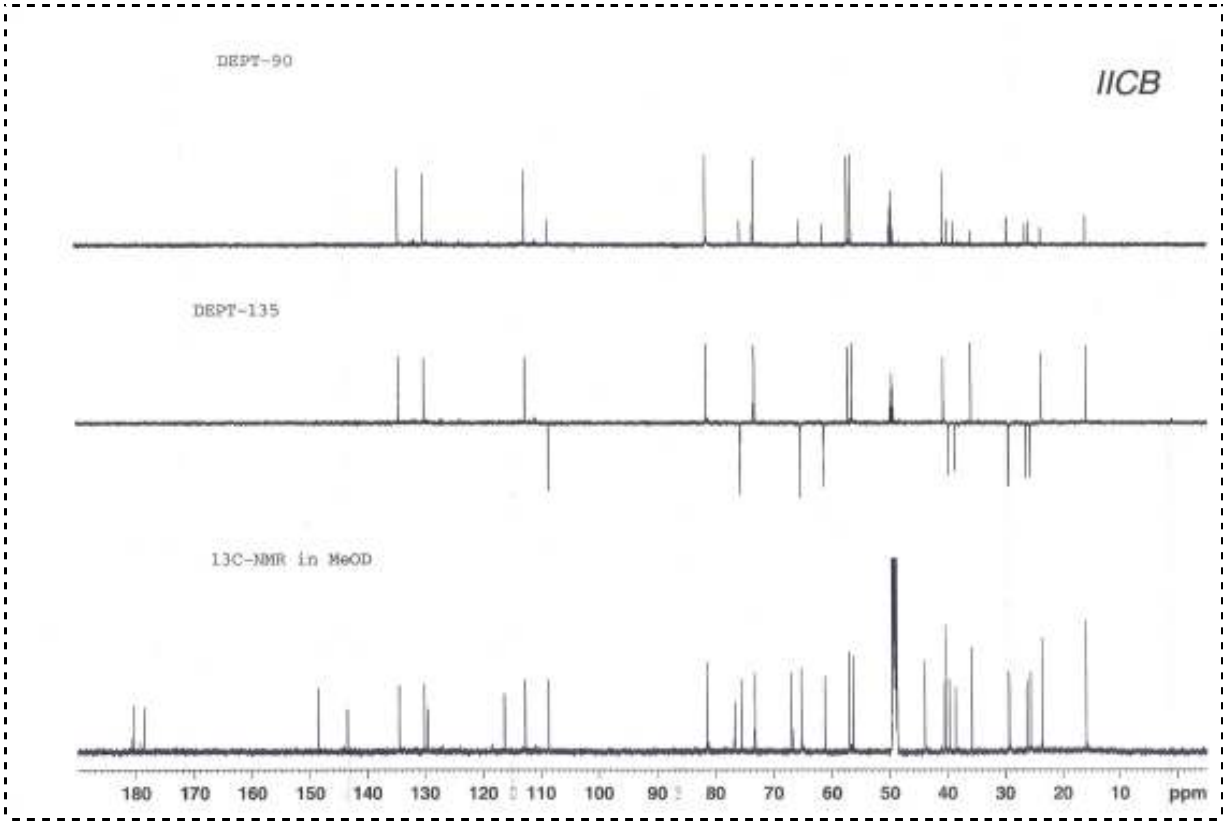

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

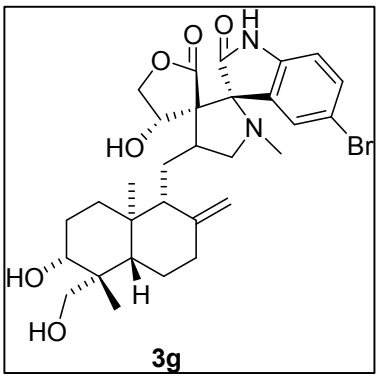

O
O
H
N
O
HO
N
OMe
HO
H
HO

3f

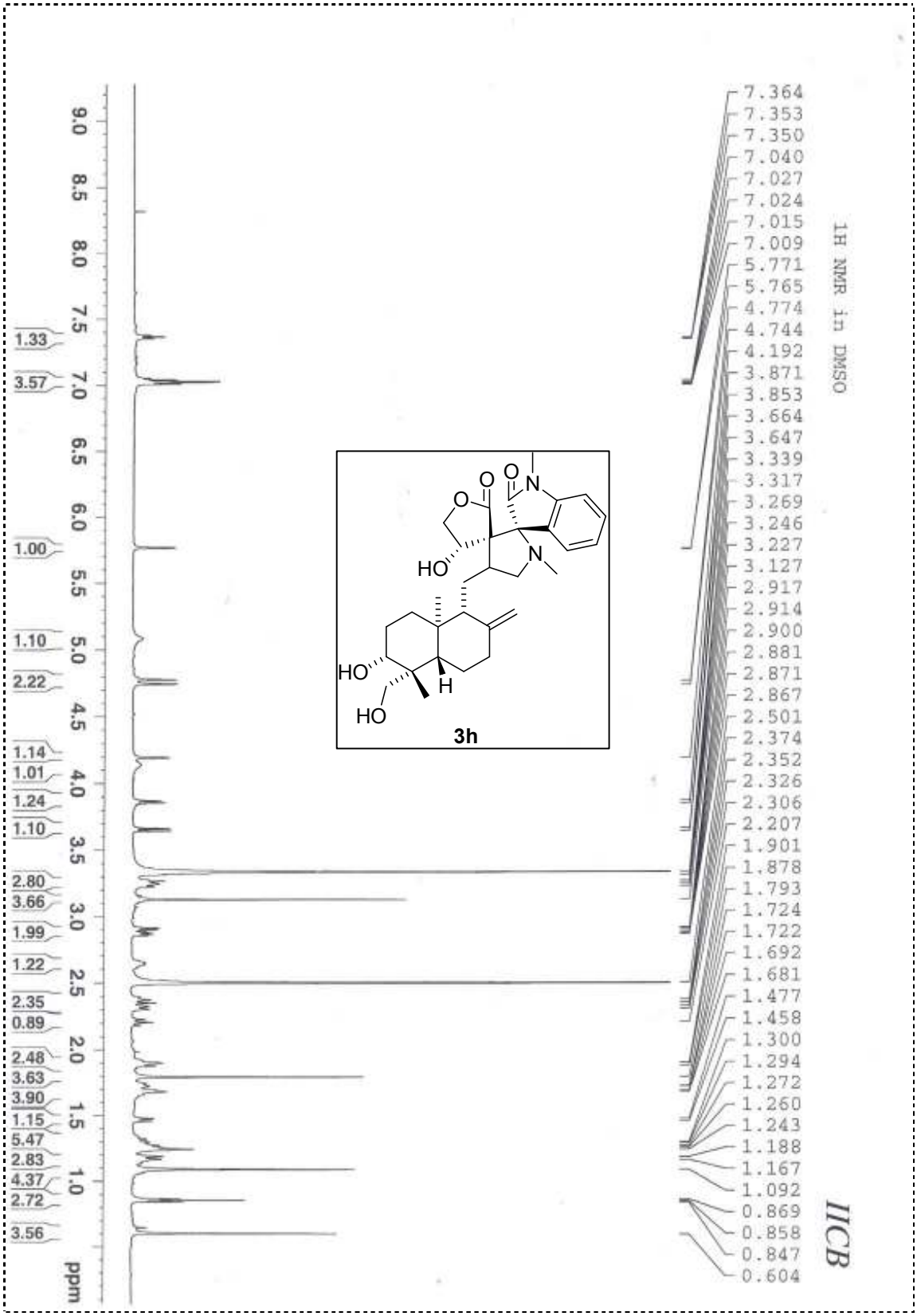

1H NMR in MeOD
7.469
7.465
7.455
7.452
7.241
7.238
6.801
6.787
4.881
4.831
4.814
4.606
4.424
4.420
4.140
4.122
3.835
3.818
3.424
3.419
3.410
3.406
3.396
3.356
3.338
3.313
3.310
3.308
3.243
3.239
3.226
3.222
3.001
2.237
2.158
2.037
2.024
2.007
2.002
1.984
1.968
1.830
1.825
1.817
1.812
1.569
1.550
1.325
1.272
1.270
1.249
1.222
1.213
1.206
0.687
IICB
3g
ppm

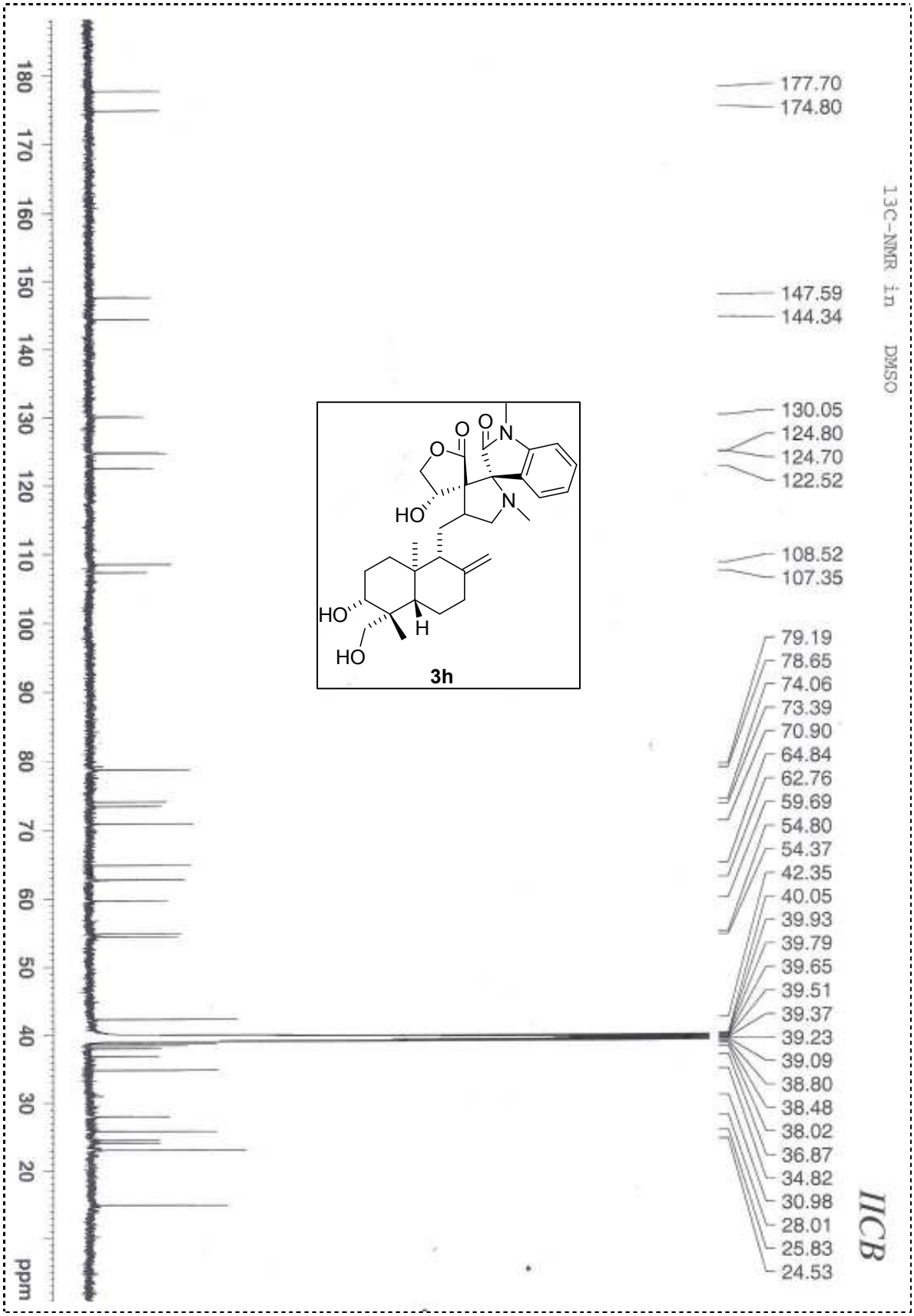

13C-NMR in MeOD
180.31
178.56
148.67
143.49
134.42
130.03
129.48
116.33
112.71
108.63
81.39
76.60
75.49
75.45
73.29
73.10
66.94
66.67
65.26
61.21
61.18
56.99
56.34
56.32
49.72
49.58
49.44
49.30
49.16
49.01
48.87
48.73
43.89
40.50
40.46
40.35
39.67
38.58
35.73
29.33
26.31
26.27
25.60
IICB
3g
ppm

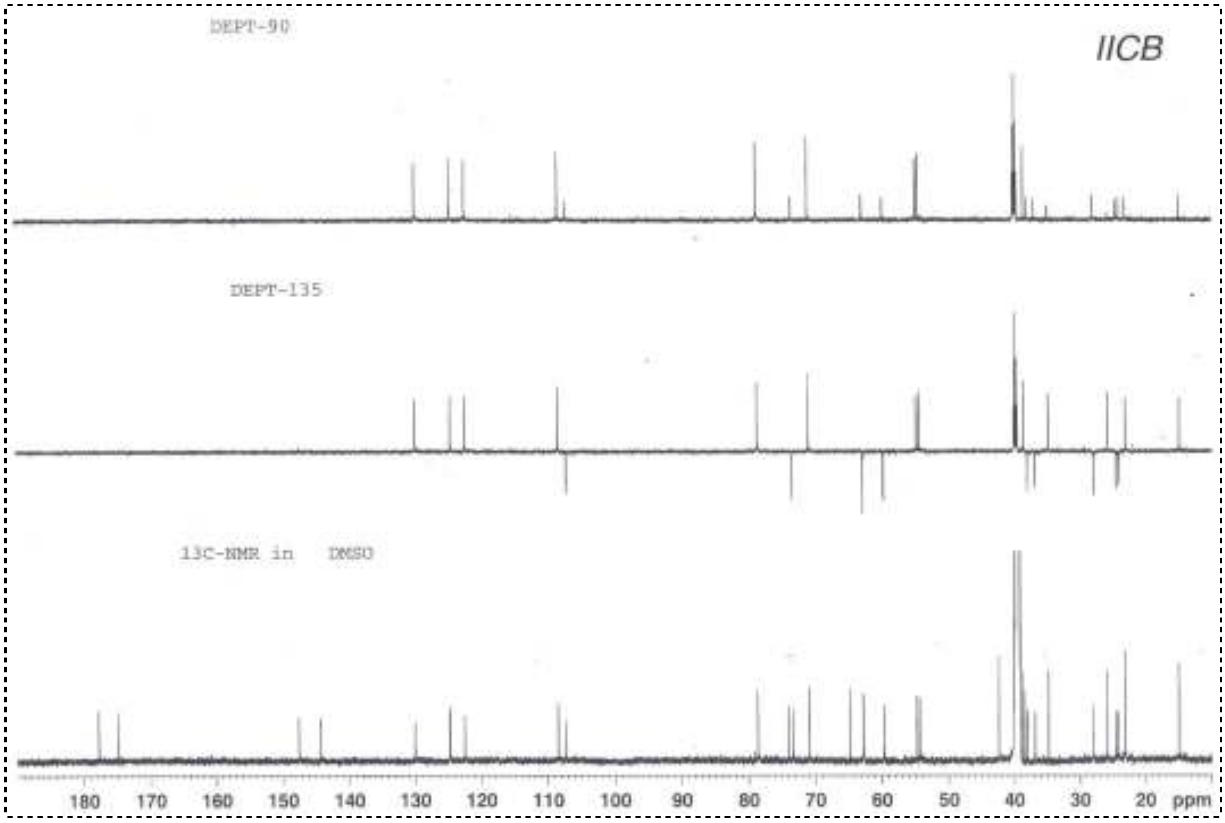

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

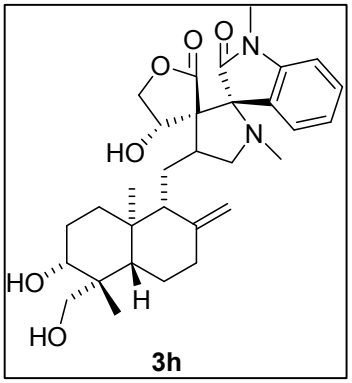

O
O
H
N
O
HO
N
Br
HO
H
HO

3g

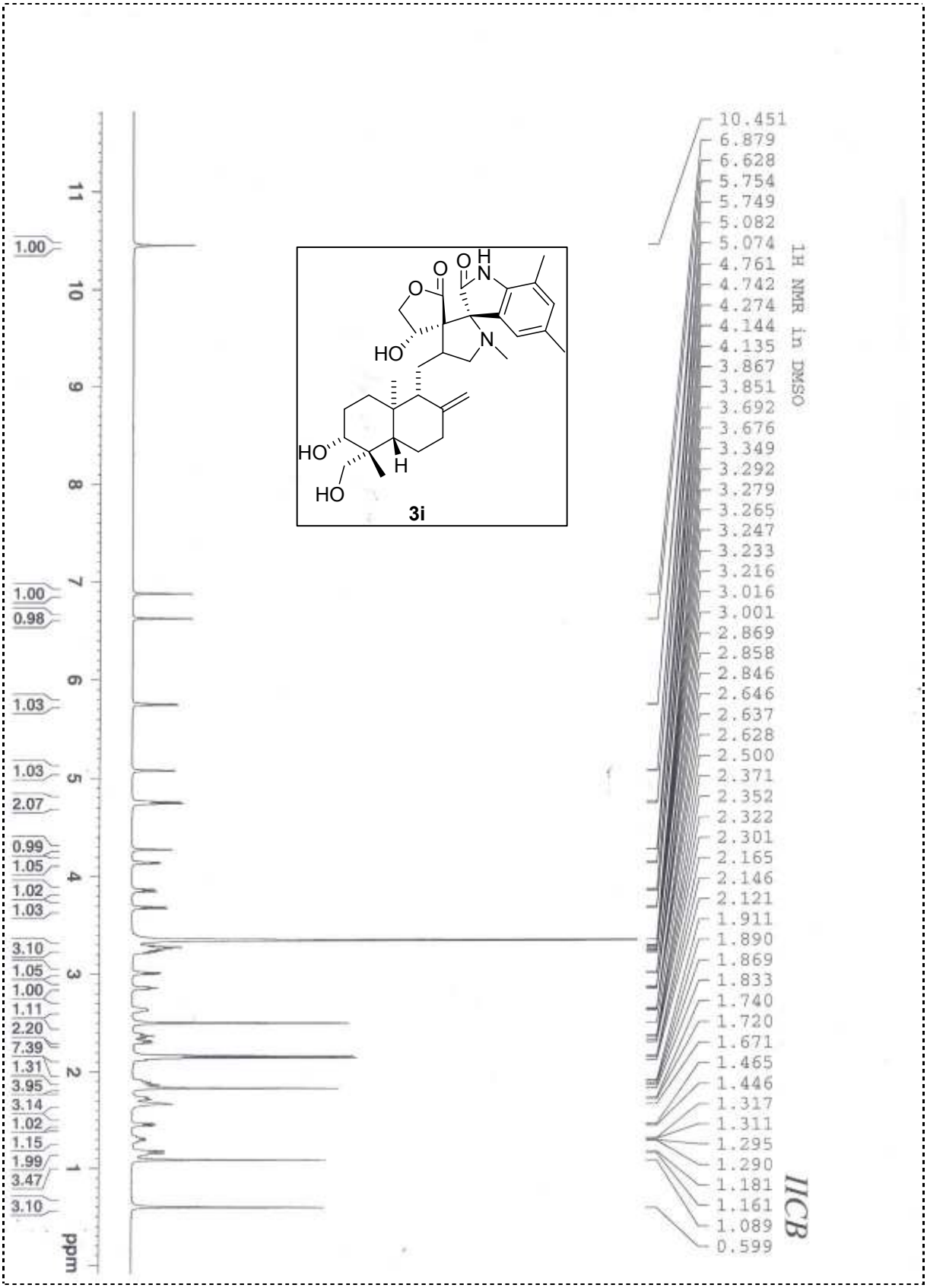

1H NMR in DMSO
7.364
7.353
7.350
7.040
7.027
7.024
7.015
7.009
5.771
5.765
4.774
4.744
4.192
3.871
3.853
3.664
3.647
3.339
3.317
3.269
3.246
3.227
3.127
2.917
2.914
2.900
2.881
2.871
2.867
2.501
2.374
2.352
2.326
2.306
2.207
1.901
1.878
1.793
1.724
1.722
1.692
1.681
1.477
1.458
1.300
1.294
1.272
1.260
1.243
1.188
1.167
1.092
0.869
0.858
0.847
0.604
IICB
3h
HO
HO
HO
H
N
N
O
O
O
1.33
3.57
1.00
1.10
2.22
1.14
1.01
1.24
1.10
2.80
3.66
1.99
1.22
2.35
0.89
2.48
3.63
3.90
1.15
5.47
2.83
4.37
2.72
3.56
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

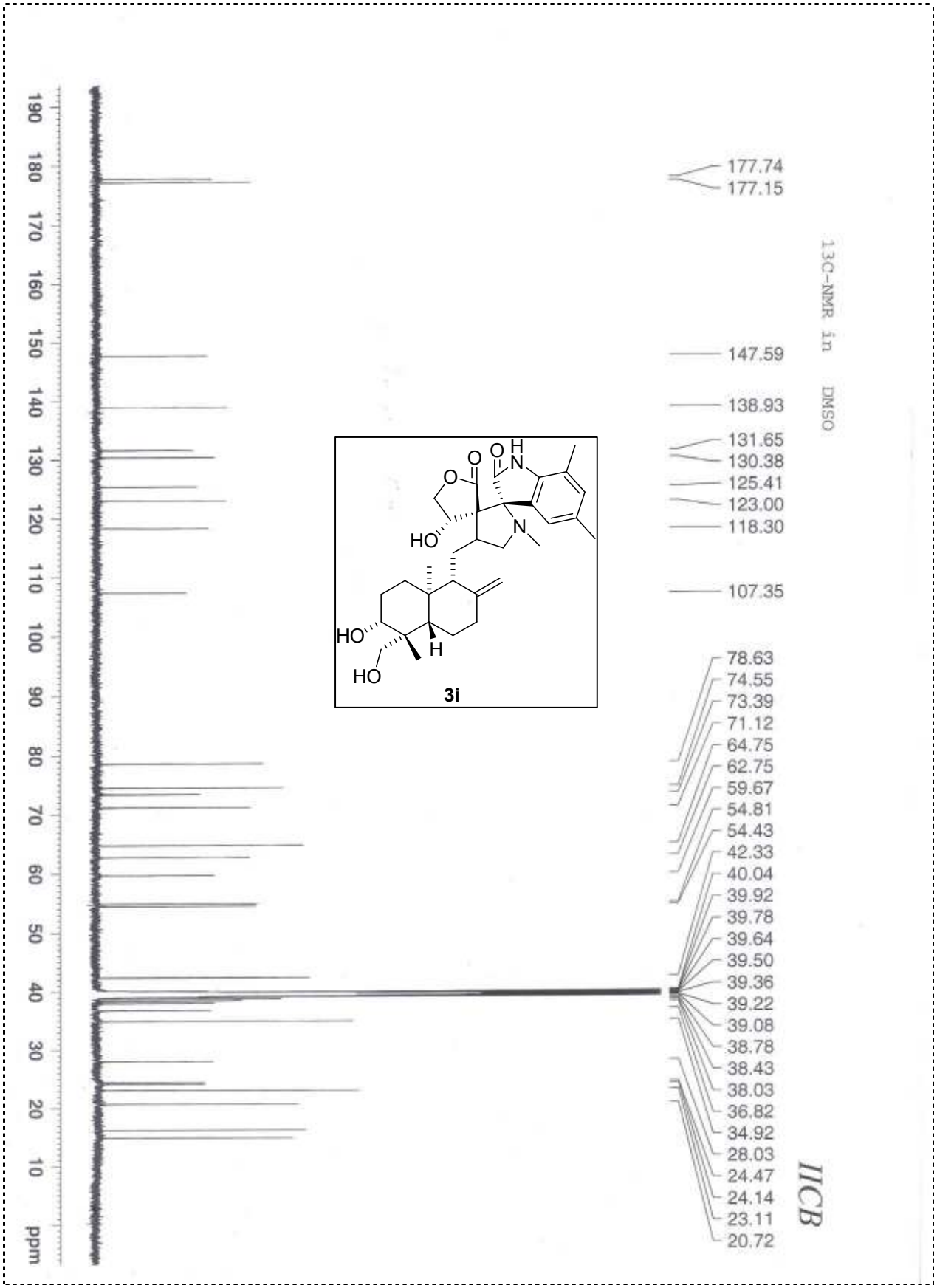

13C-NMR in DMSO
177.70
174.80
147.59
144.34
130.05
124.80
124.70
122.52
108.52
107.35
79.19
78.65
74.06
73.39
70.90
64.84
62.76
59.69
54.80
54.37
42.35
40.05
39.93
39.79
39.65
39.51
39.37
39.23
39.09
38.80
38.48
38.02
36.87
34.82
30.98
28.01
25.83
24.53
IICB
ppm
3h

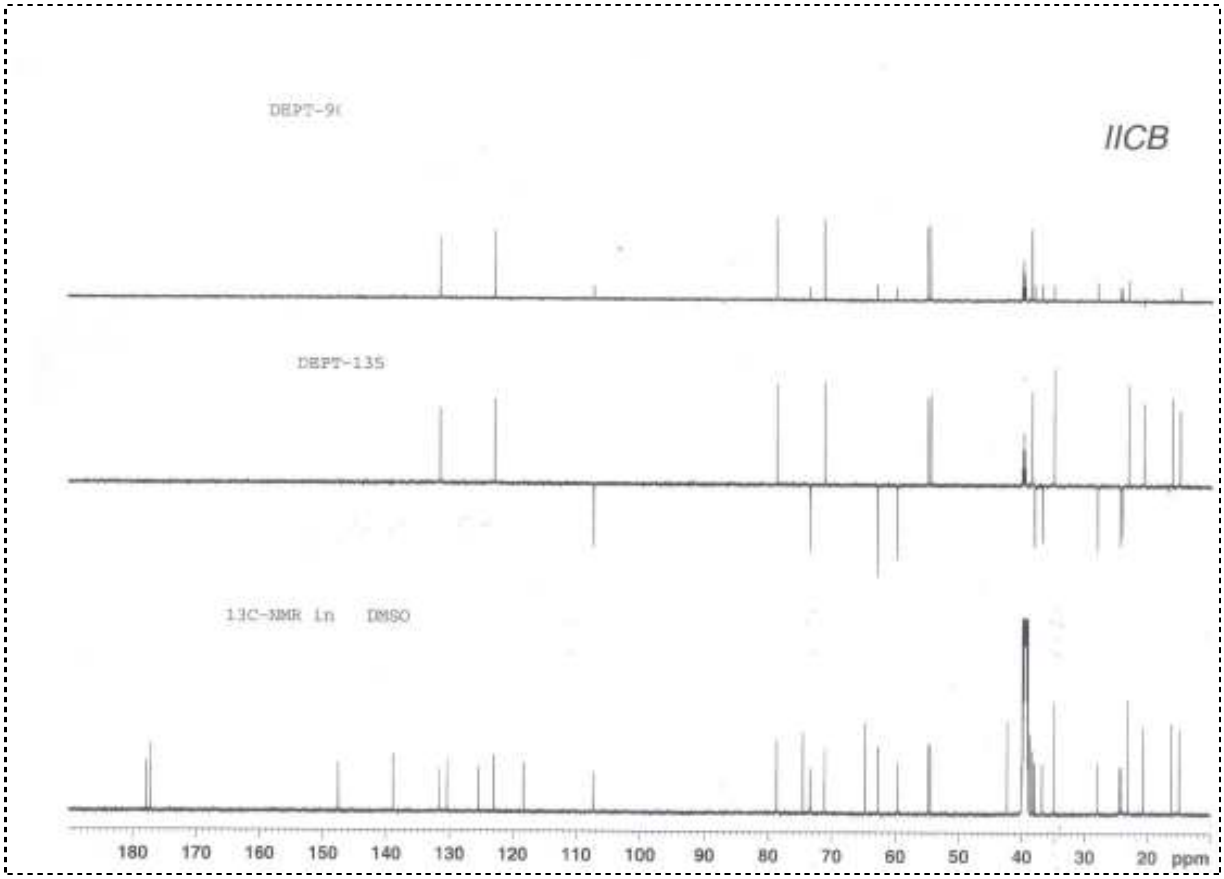

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

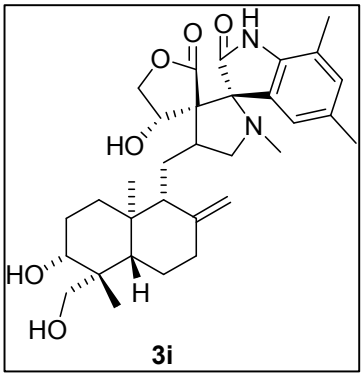

O
O
N
O
HO
N
HO
H
HO

3h

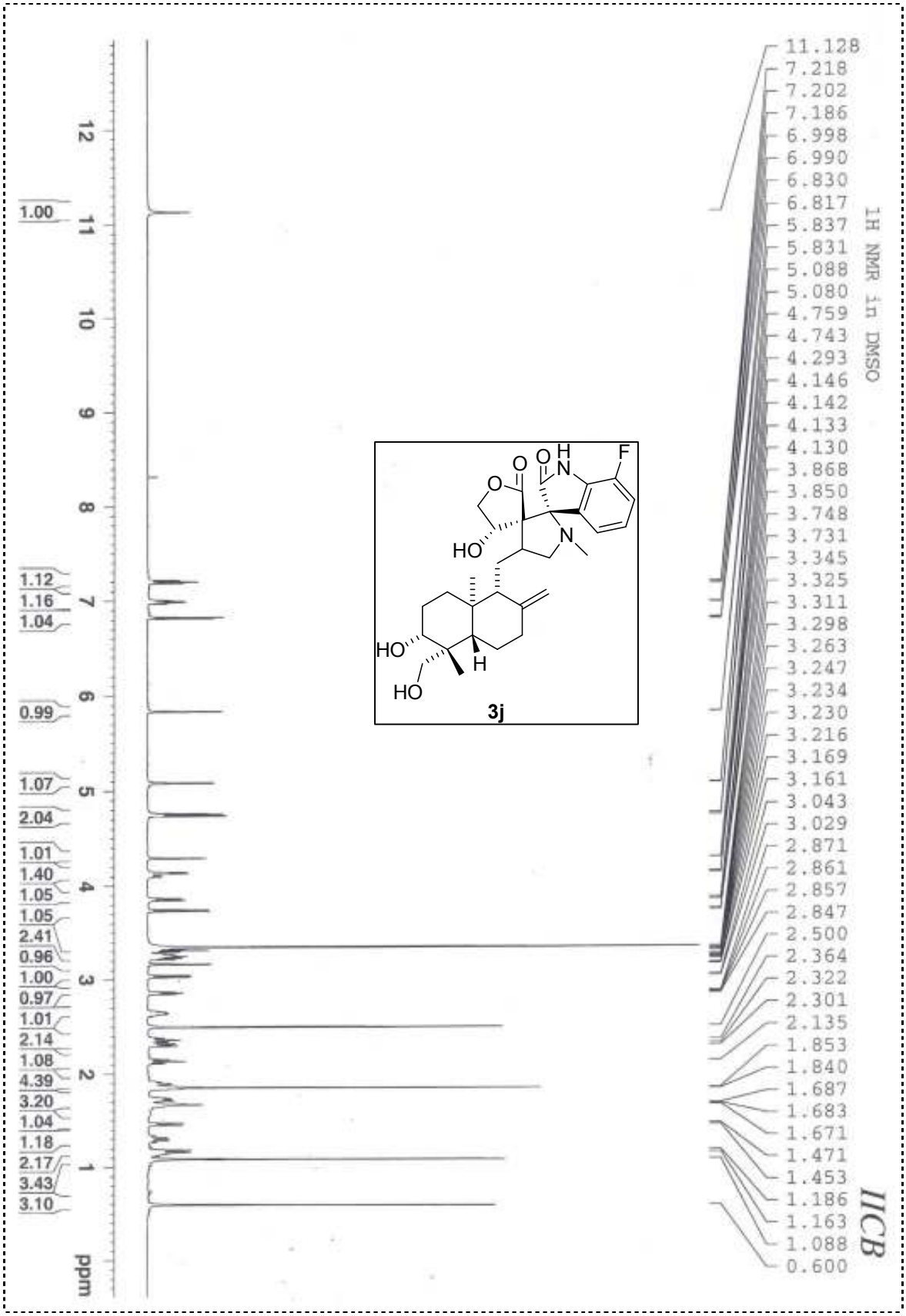

1H NMR in DMSO
10.451
6.879
6.628
5.754
5.749
5.082
5.074
4.761
4.742
4.274
4.144
4.135
3.867
3.851
3.692
3.676
3.349
3.292
3.279
3.265
3.247
3.233
3.216
3.016
3.001
2.869
2.858
2.846
2.646
2.637
2.628
2.500
2.371
2.352
2.322
2.301
2.165
2.146
2.121
1.911
1.890
1.869
1.833
1.740
1.720
1.671
1.465
1.446
1.317
1.311
1.295
1.290
1.181
1.161
1.089
0.599
1.00
1.00
0.98
1.03
1.03
2.07
0.99
1.05
1.02
1.03
3.10
1.05
1.00
1.11
2.20
7.39
1.31
3.95
3.14
1.02
1.15
1.99
3.47
3.10
ppm
HO
HO
HO
H
N
O
O
O
H
N
3i
IICB

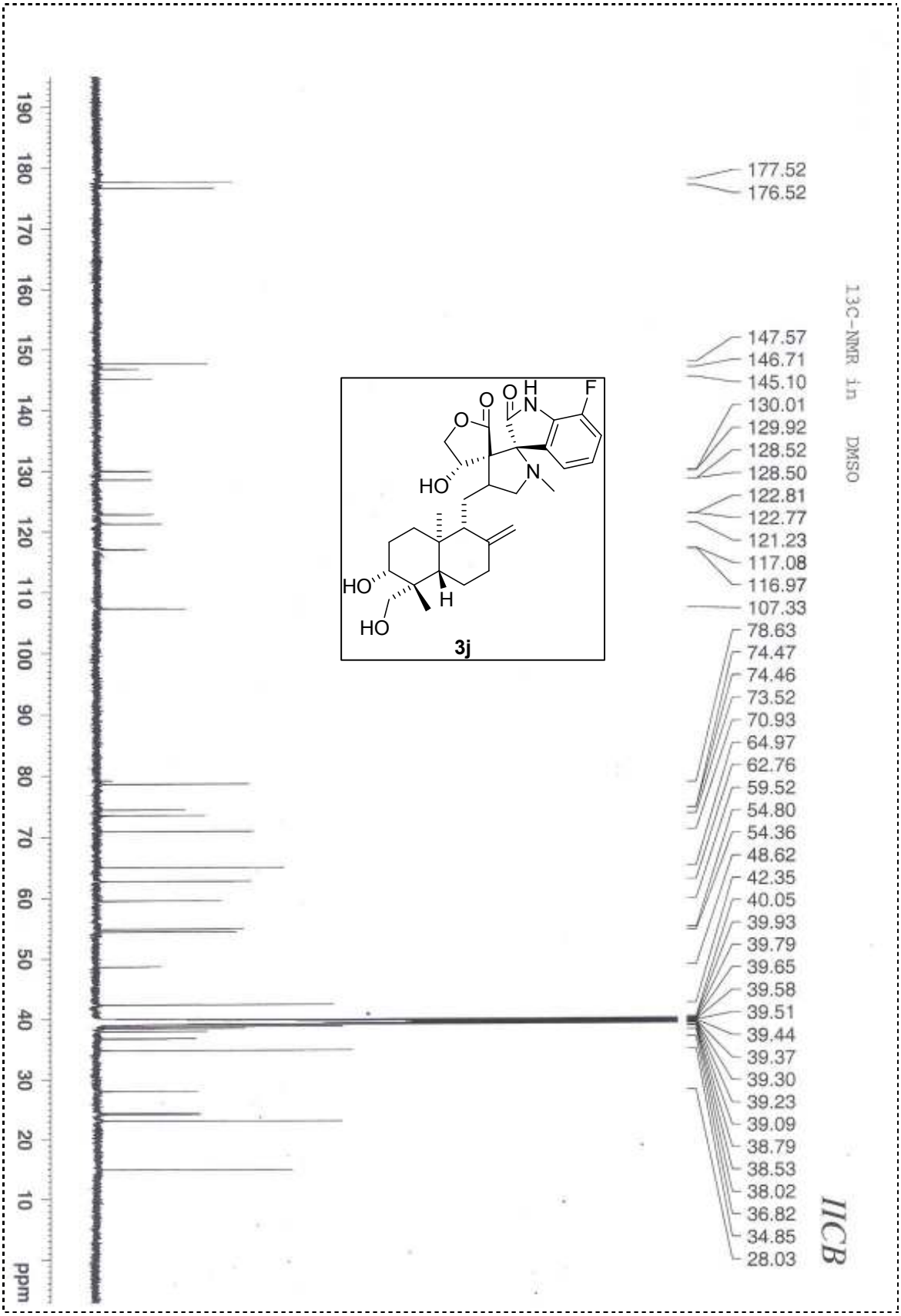

13C-NMR in DMSO
177.74
177.15
147.59
138.93
131.65
130.38
125.41
123.00
118.30
107.35
78.63
74.55
73.39
71.12
64.75
62.75
59.67
54.81
54.43
42.33
40.04
39.92
39.78
39.64
39.50
39.36
39.22
39.08
38.78
38.43
38.03
36.82
34.92
28.03
24.47
24.14
23.11
20.72
IICB
3i
ppm

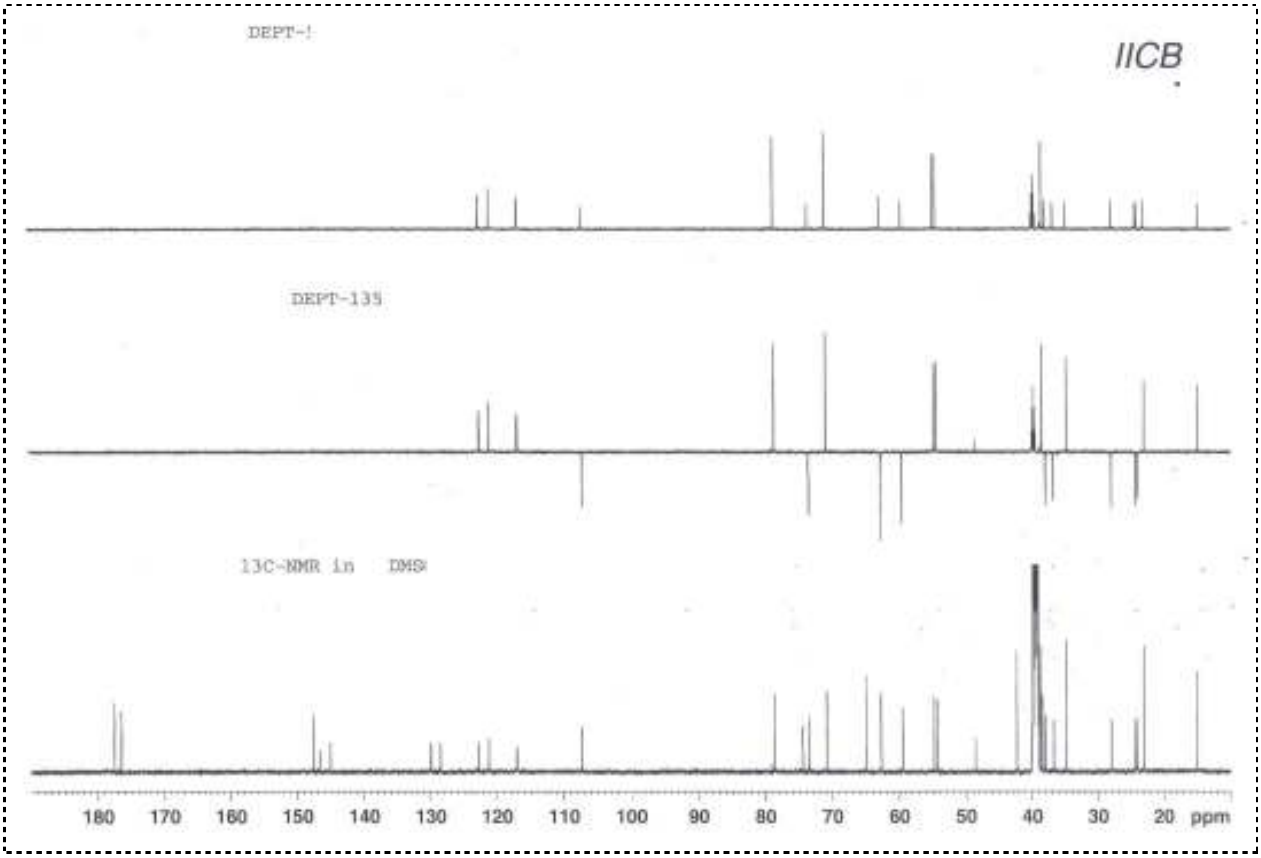

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

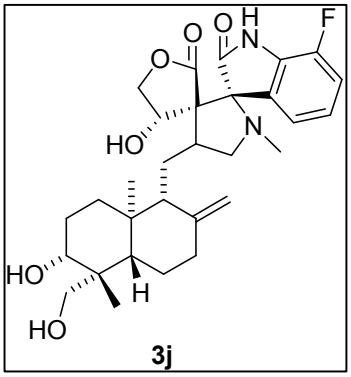

O
O
H
N
O
N
HO
HO
H
HO

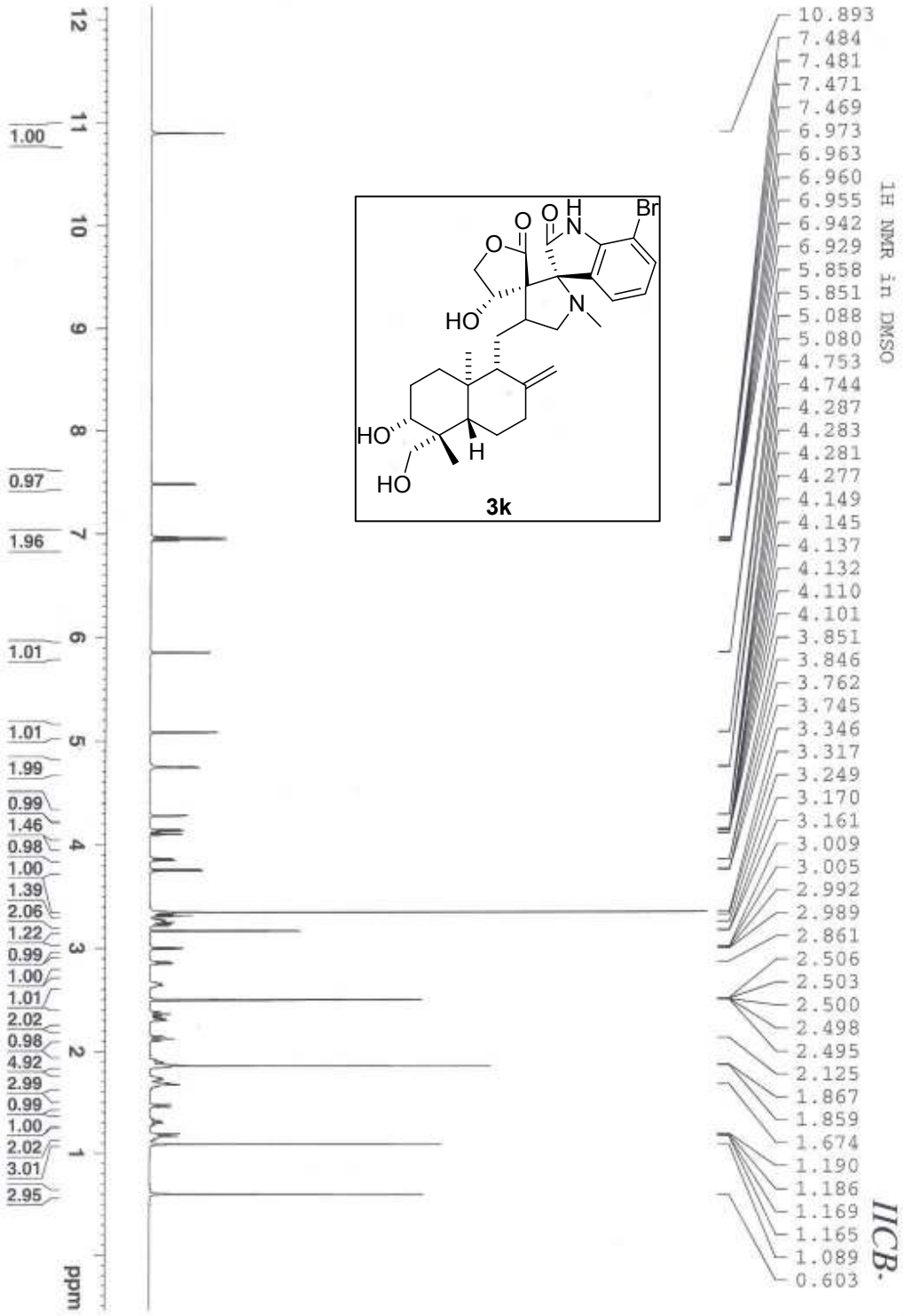
3i

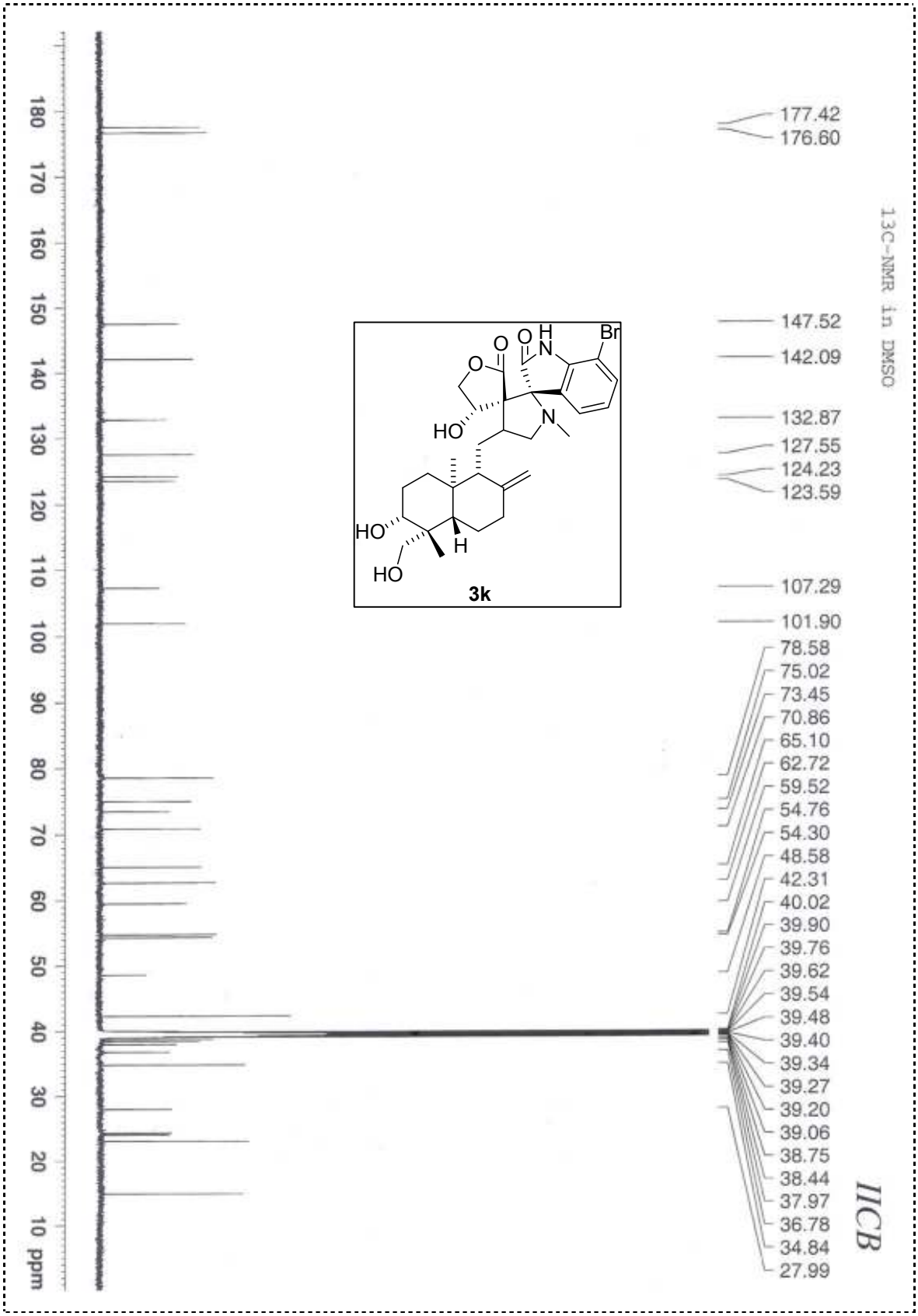

1H NMR in DMSO
11.128
7.218
7.202
7.186
6.998
6.990
6.830
6.817
5.837
5.831
5.088
5.080
4.759
4.743
4.293
4.146
4.142
4.133
4.130
3.868
3.850
3.748
3.731
3.345
3.325
3.311
3.298
3.263
3.247
3.234
3.230
3.216
3.169
3.161
3.043
3.029
2.871
2.861
2.857
2.847
2.500
2.364
2.322
2.301
2.135
1.853
1.840
1.687
1.683
1.671
1.471
1.453
1.186
1.163
1.088
0.600
1.00
1.12
1.16
1.04
0.99
1.07
2.04
1.01
1.40
1.05
1.05
2.41
0.96
1.00
0.97
1.01
2.14
1.08
4.39
3.20
1.04
1.18
2.17
3.43
3.10
ppm
12
11
10
9
8
7
6
5
4
3
2
1
IICB
3j

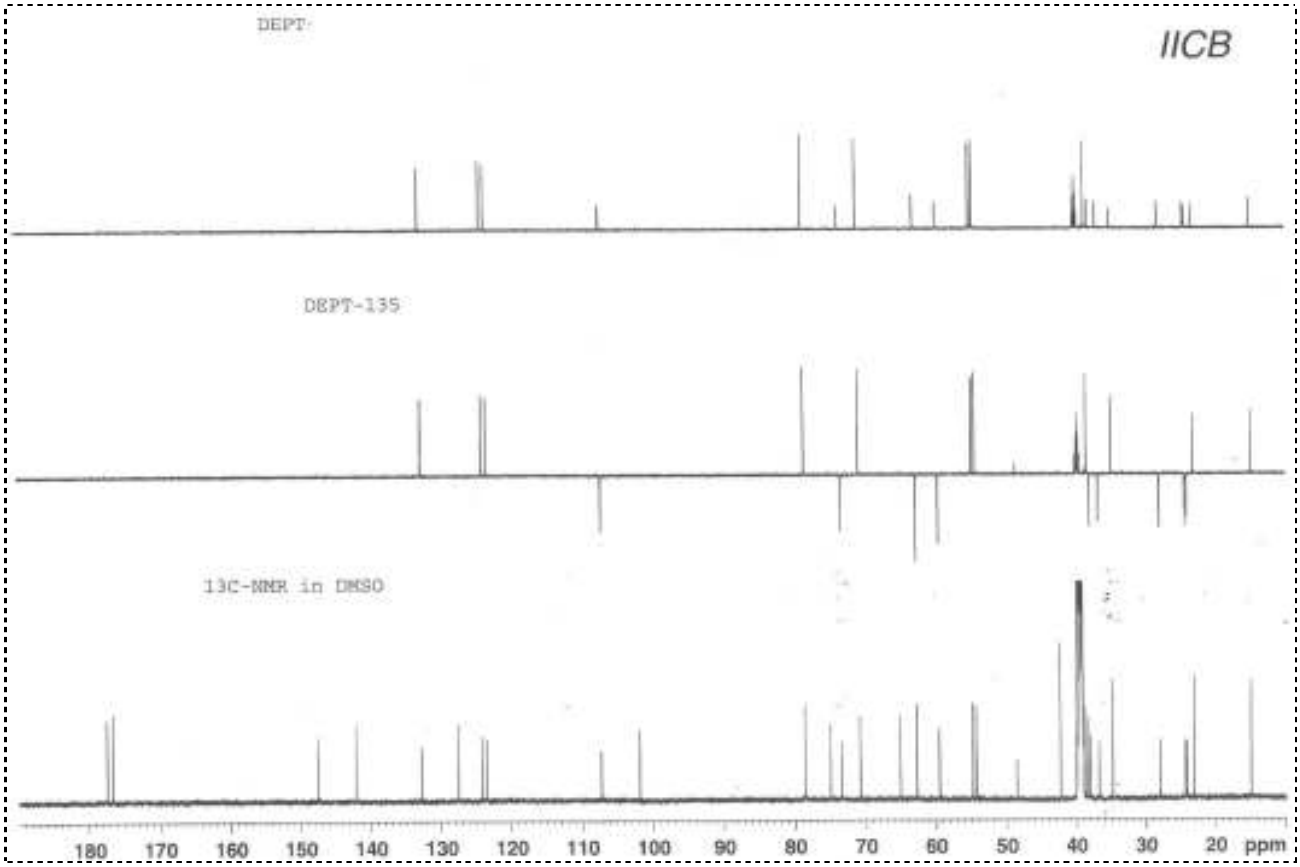

13C-NMR in DMSO
177.52
176.52
147.57
146.71
145.10
130.01
129.92
128.52
128.50
122.81
122.77
121.23
117.08
116.97
107.33
78.63
74.47
74.46
73.52
70.93
64.97
62.76
59.52
54.80
54.36
48.62
42.35
40.05
39.93
39.79
39.65
39.58
39.51
39.44
39.37
39.30
39.23
39.09
38.79
38.53
38.02
36.82
34.85
28.03
IICB
3j
ppm

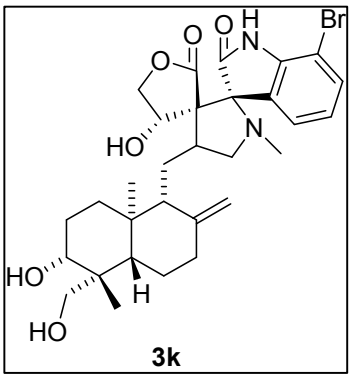

DEPT-1
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
H
N
F
O
N
HO
HO
H
HO
3j

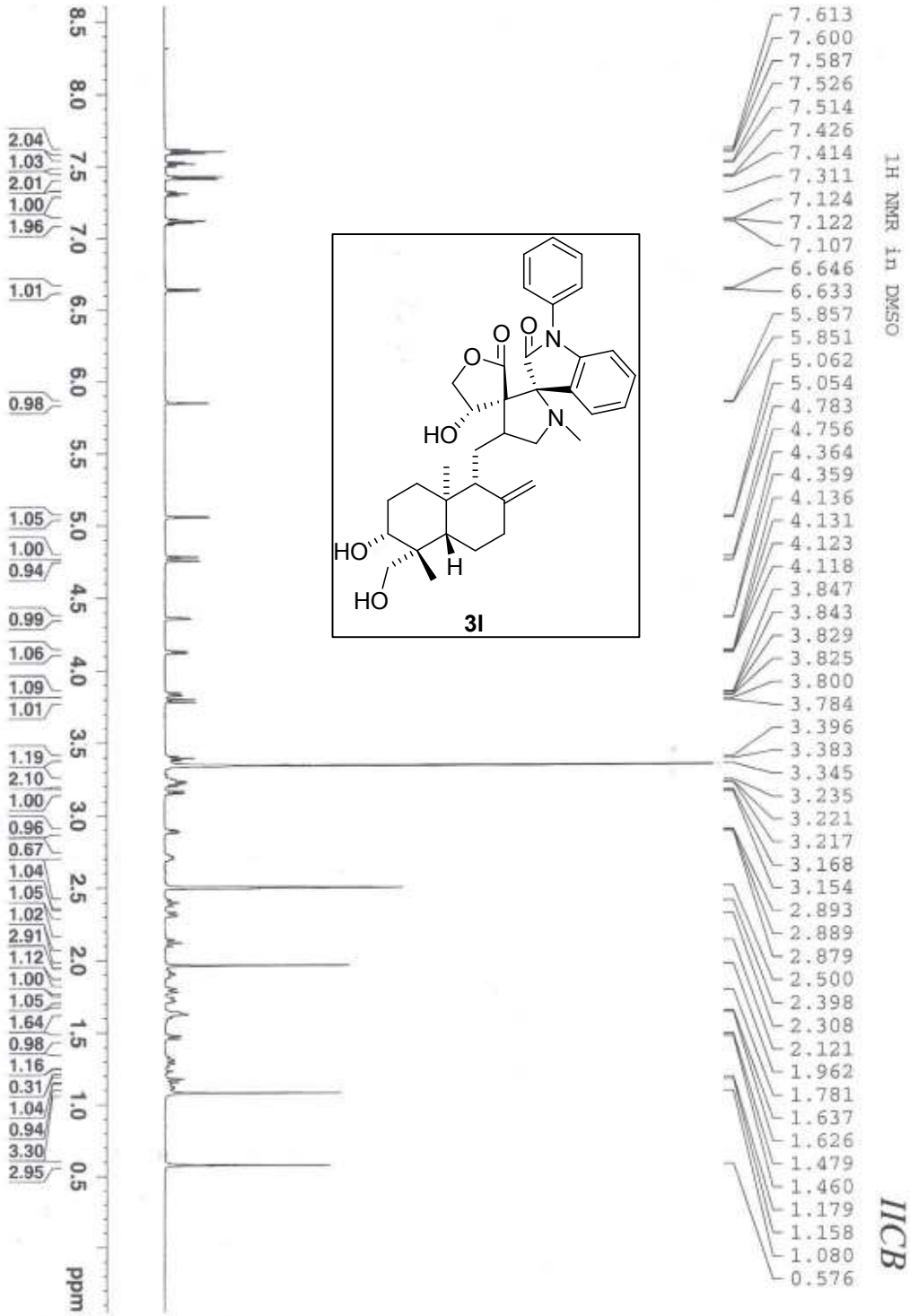

1H NMR in DMSO
10.893
7.484
7.481
7.471
7.469
6.973
6.963
6.960
6.955
6.942
6.929
5.858
5.851
5.088
5.080
4.753
4.744
4.287
4.283
4.281
4.277
4.149
4.145
4.137
4.132
4.110
4.101
3.851
3.846
3.762
3.745
3.346
3.317
3.249
3.170
3.161
3.009
3.005
2.992
2.989
2.861
2.506
2.503
2.500
2.498
2.495
2.125
1.867
1.859
1.674
1.190
1.186
1.169
1.165
1.089
0.603
1.00
0.97
1.96
1.01
1.01
1.99
0.99
1.46
0.98
1.00
1.39
2.06
1.22
0.99
1.00
1.01
2.02
0.98
4.92
2.99
0.99
1.00
2.02
3.01
2.95
ppm
HO
HO
HO
H
O
O
O
H
N
Br
N
3k
IICB-

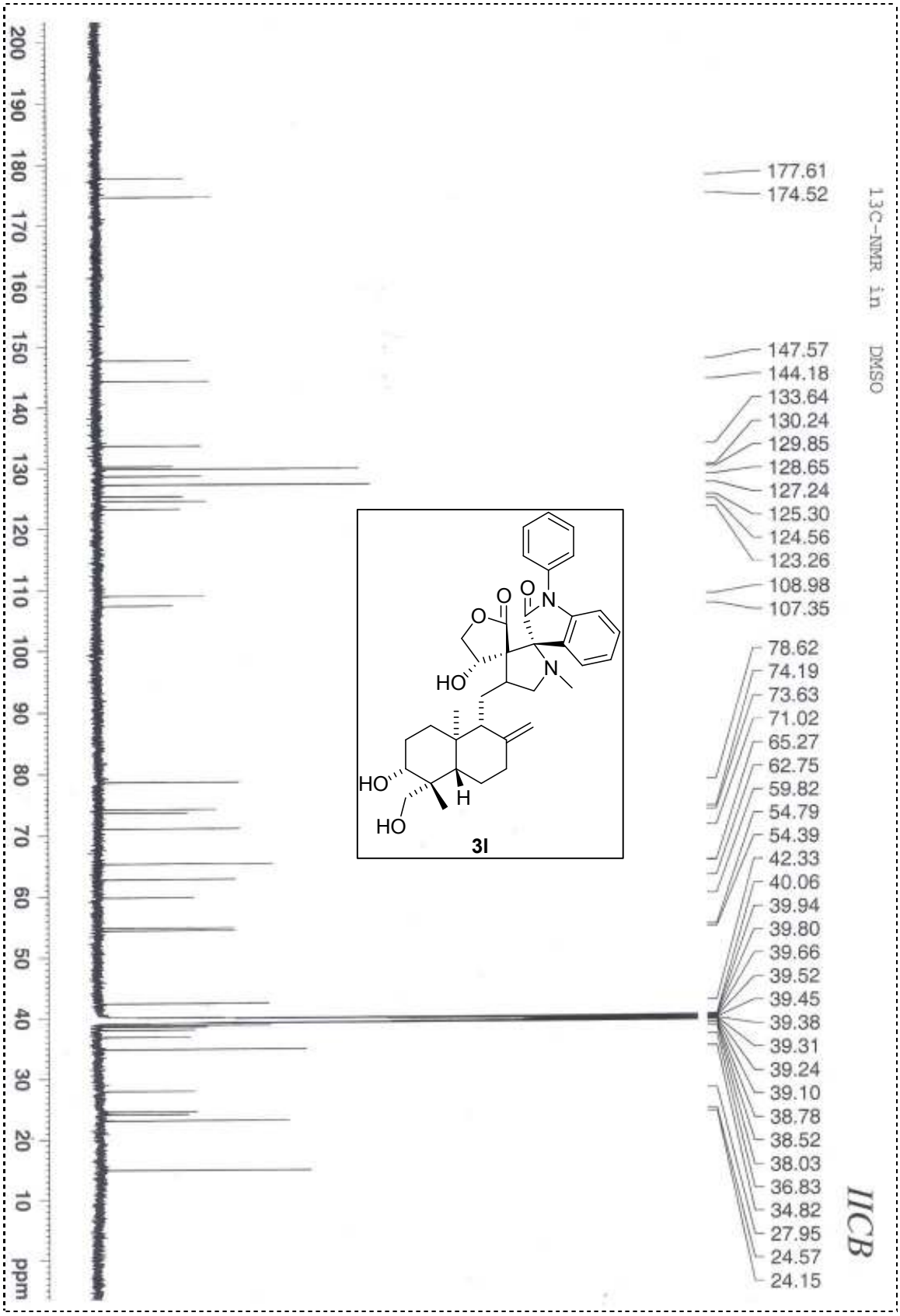

13C-NMR in DMSO
177.42
176.60
147.52
142.09
132.87
127.55
124.23
123.59
107.29
101.90
78.58
75.02
73.45
70.86
65.10
62.72
59.52
54.76
54.30
48.58
42.31
40.02
39.90
39.76
39.62
39.54
39.48
39.40
39.34
39.27
39.20
39.06
38.75
38.44
37.97
36.78
34.84
27.99
IICB
3k
ppm

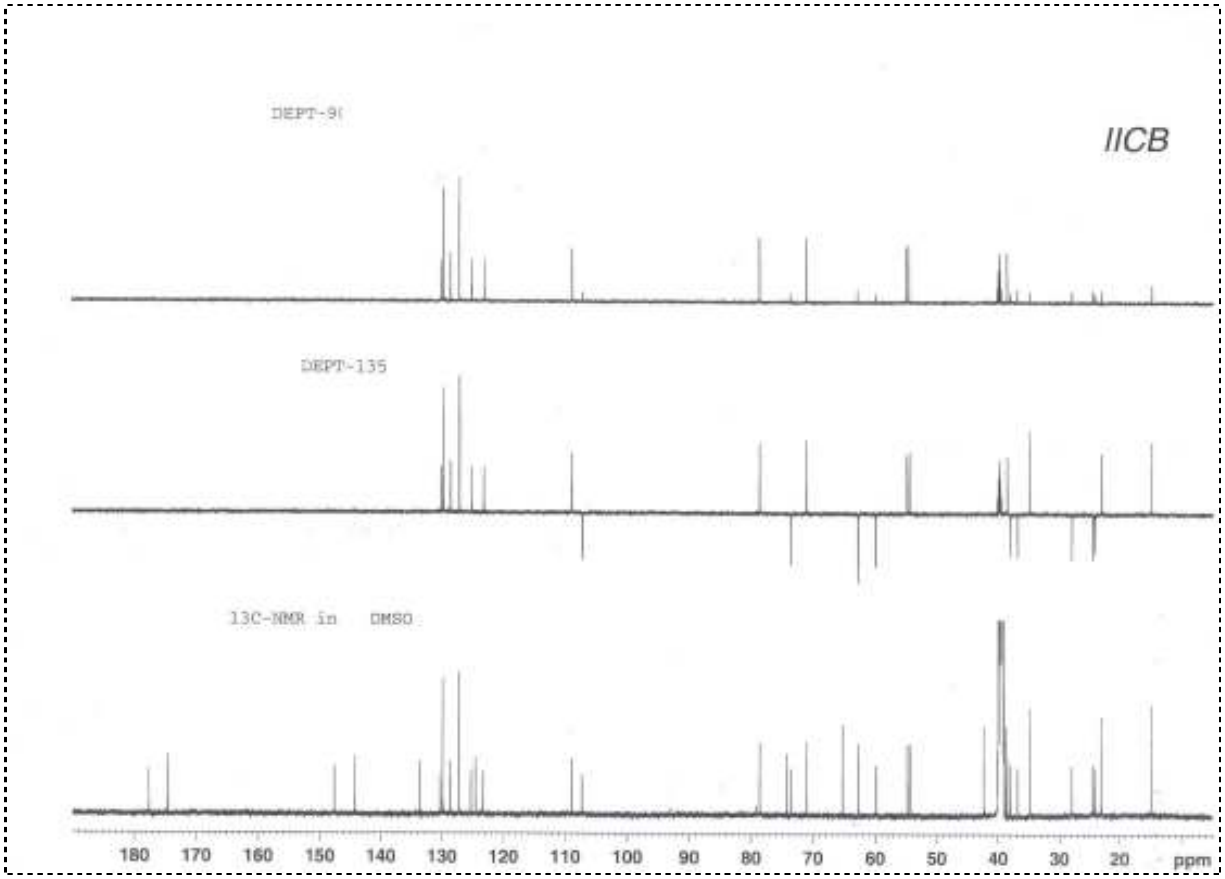

DEPT
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

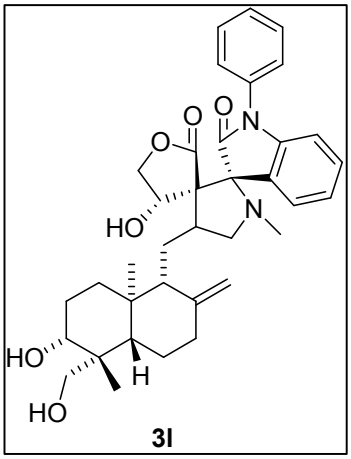

Br
O
O
O
H
N
N
HO
HO
H
HO

3k

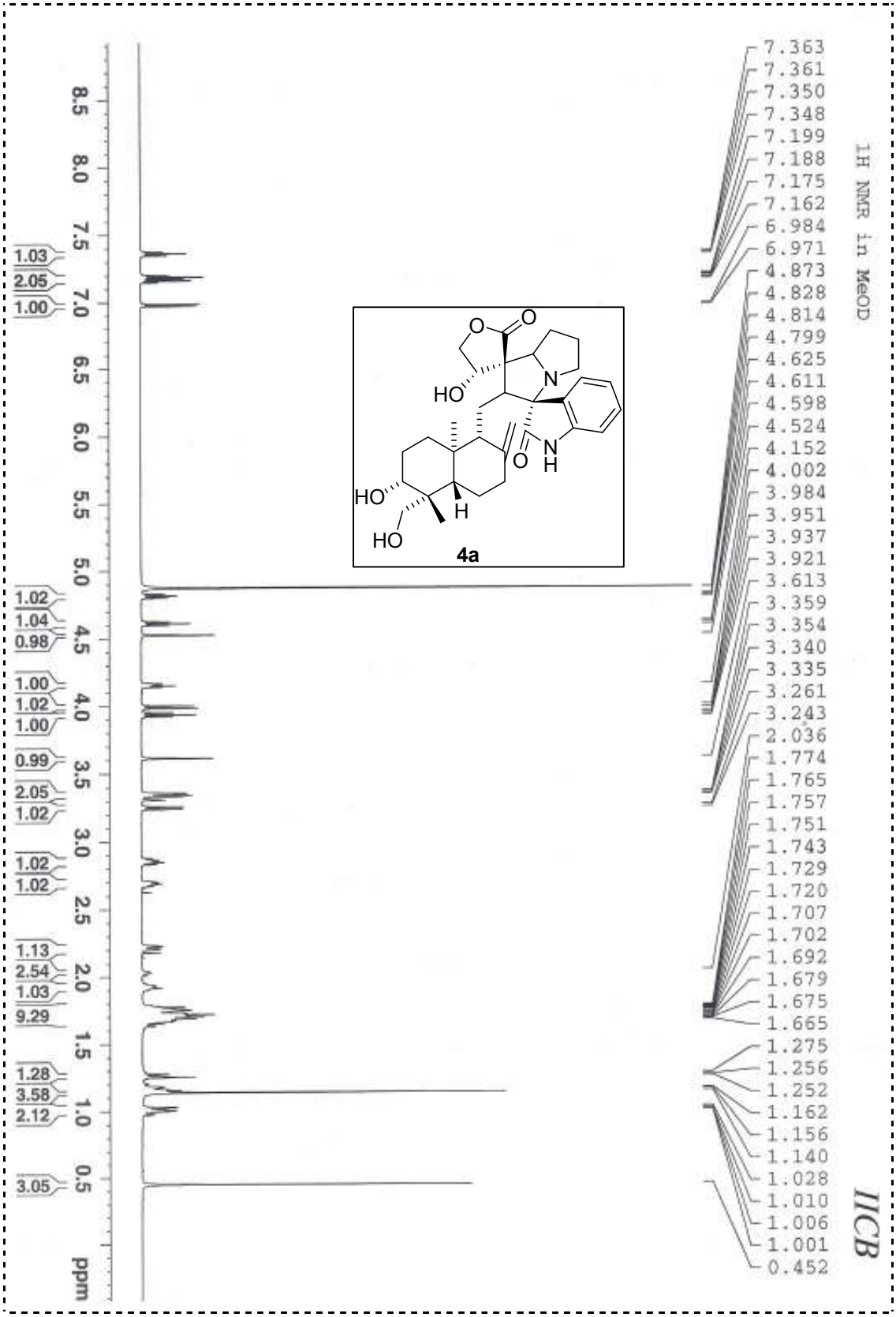

1H NMR in DMSO
7.613
7.600
7.587
7.526
7.514
7.426
7.414
7.311
7.124
7.122
7.107
6.646
6.633
5.857
5.851
5.062
5.054
4.783
4.756
4.364
4.359
4.136
4.131
4.123
4.118
3.847
3.843
3.829
3.825
3.800
3.784
3.396
3.383
3.345
3.235
3.221
3.217
3.168
3.154
2.893
2.889
2.879
2.500
2.398
2.308
2.121
1.962
1.781
1.637
1.626
1.479
1.460
1.179
1.158
1.080
0.576
IICB
2.04
1.03
2.01
1.00
1.96
1.01
0.98
1.05
1.00
0.94
0.99
1.06
1.09
1.01
1.19
2.10
1.00
0.96
0.67
1.04
1.05
1.02
2.91
1.12
1.00
1.05
1.64
0.98
1.16
0.31
1.04
0.94
3.30
2.95
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
O
O
O
N
N
HO
HO
HO
H
3I

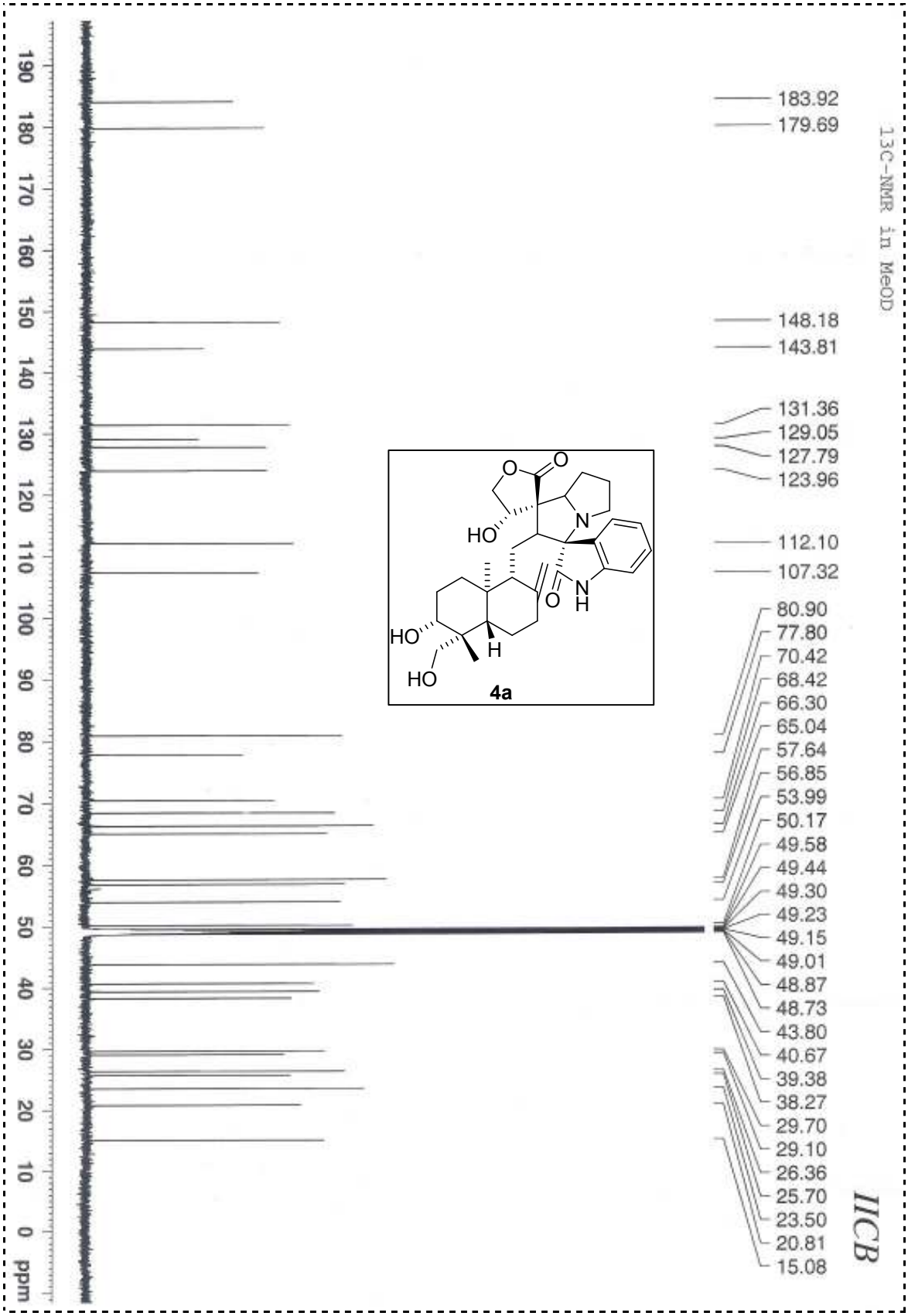

13C-NMR in DMSO
177.61
174.52
147.57
144.18
133.64
130.24
129.85
128.65
127.24
125.30
124.56
123.26
108.98
107.35
78.62
74.19
73.63
71.02
65.27
62.75
59.82
54.79
54.39
42.33
40.06
39.94
39.80
39.66
39.52
39.45
39.38
39.31
39.24
39.10
38.78
38.52
38.03
36.83
34.82
27.95
24.57
24.15
ppm
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
HO
HO
HO
H
N
O
O
O
N
3l
IICB

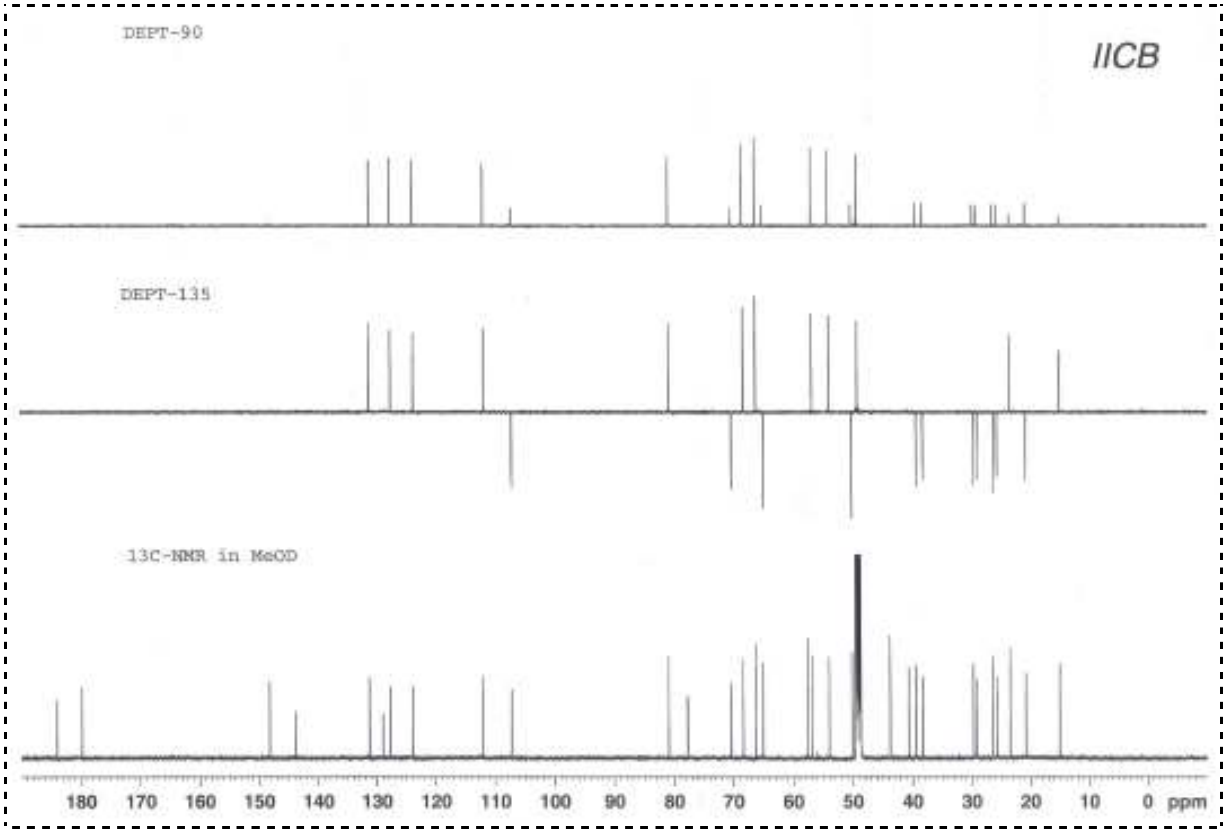

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

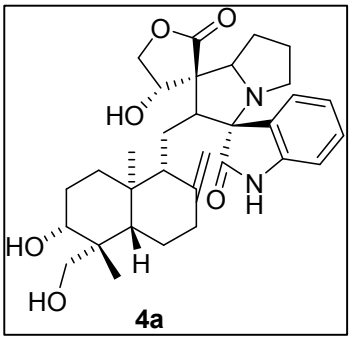

O
O
O
N
N
HO
HO
HO
H

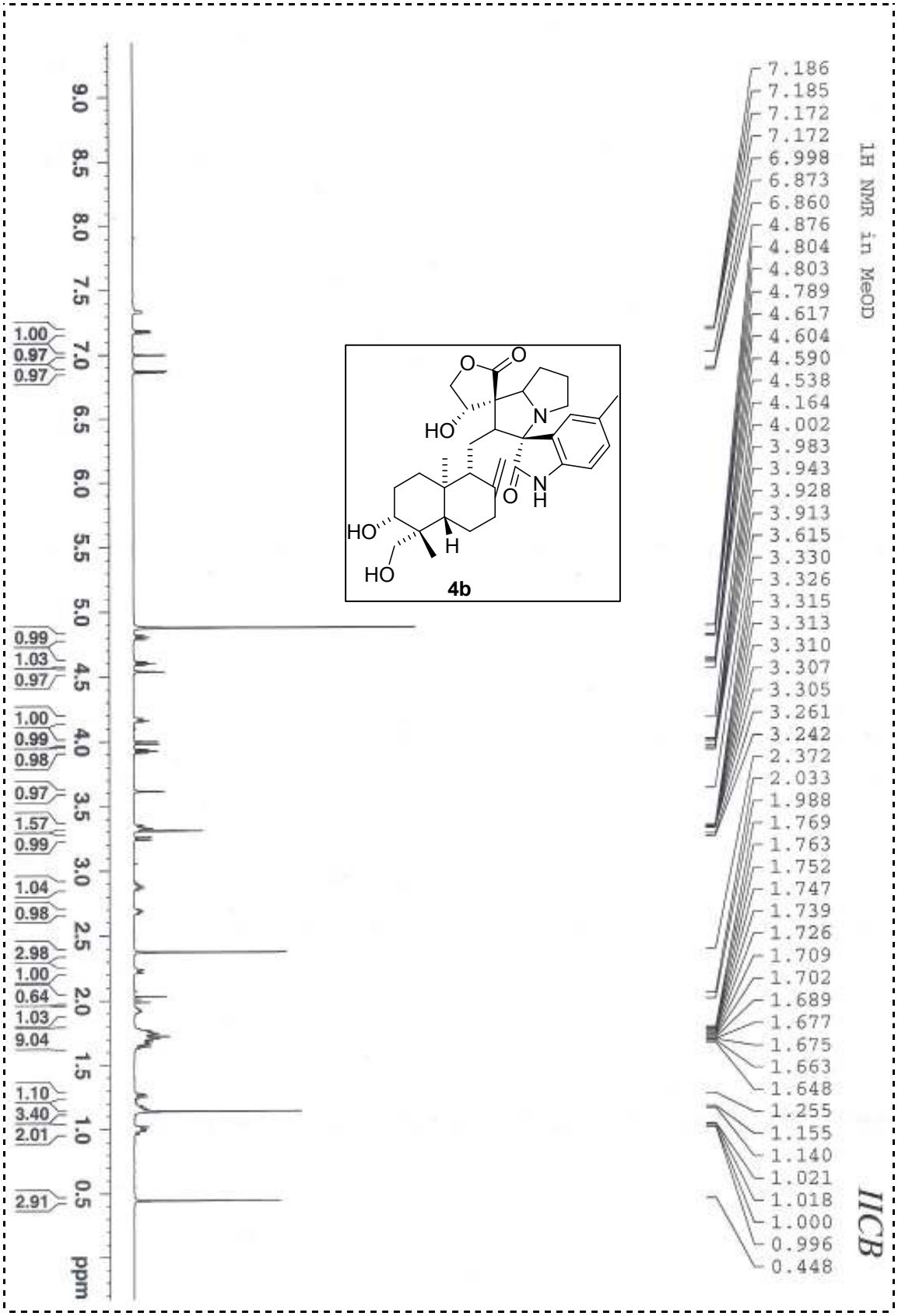
3l

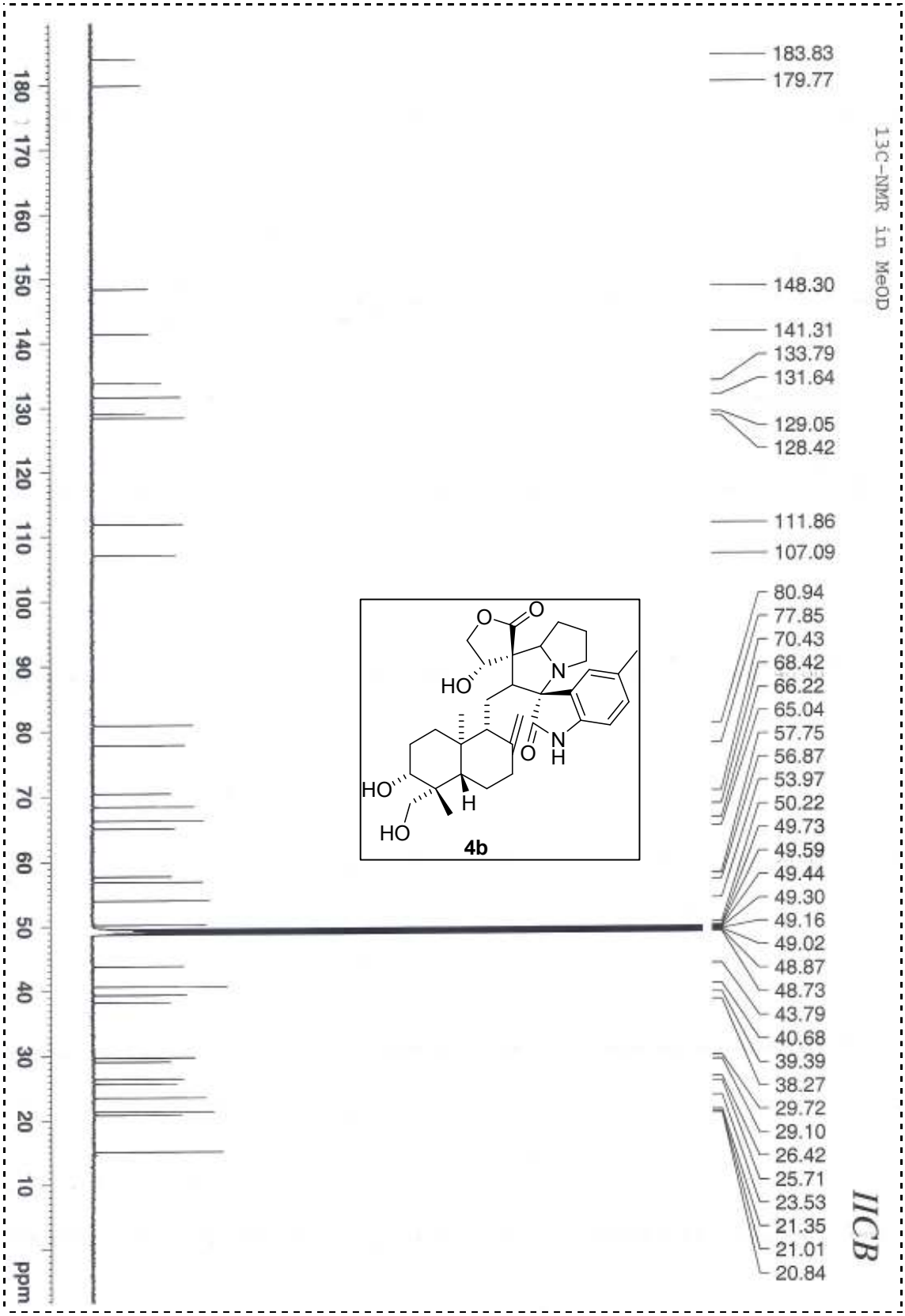

1H NMR in MeOD
7.363
7.361
7.350
7.348
7.199
7.188
7.175
7.162
6.984
6.971
4.873
4.828
4.814
4.799
4.625
4.611
4.598
4.524
4.152
4.002
3.984
3.951
3.937
3.921
3.613
3.359
3.354
3.340
3.335
3.261
3.243
2.036
1.774
1.765
1.757
1.751
1.743
1.729
1.720
1.707
1.702
1.692
1.679
1.675
1.665
1.275
1.256
1.252
1.162
1.156
1.140
1.028
1.010
1.006
1.001
0.452
IICB
4a
HO
O
O
N
H
N
O
HO
H
HO
1.03
2.05
1.00
1.02
1.04
0.98
1.00
1.02
1.00
0.99
2.05
1.02
1.02
1.02
1.13
2.54
1.03
9.29
1.28
3.58
2.12
3.05
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

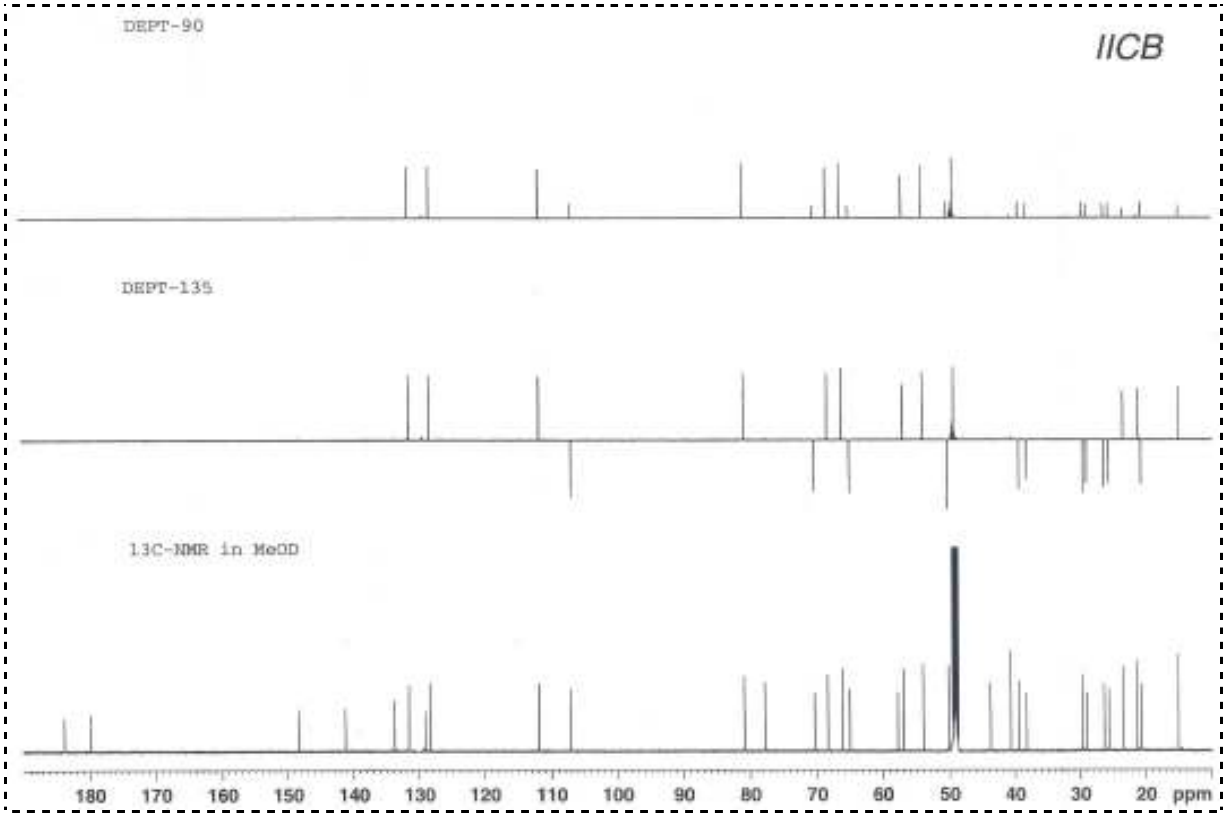

13C-NMR in MeOD
183.92
179.69
148.18
143.81
131.36
129.05
127.79
123.96
112.10
107.32
80.90
77.80
70.42
68.42
66.30
65.04
57.64
56.85
53.99
50.17
49.58
49.44
49.30
49.23
49.15
49.01
48.87
48.73
43.80
40.67
39.38
38.27
29.70
29.10
26.36
25.70
23.50
20.81
15.08
IICB
4a
ppm

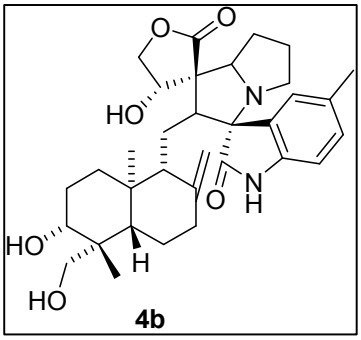

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

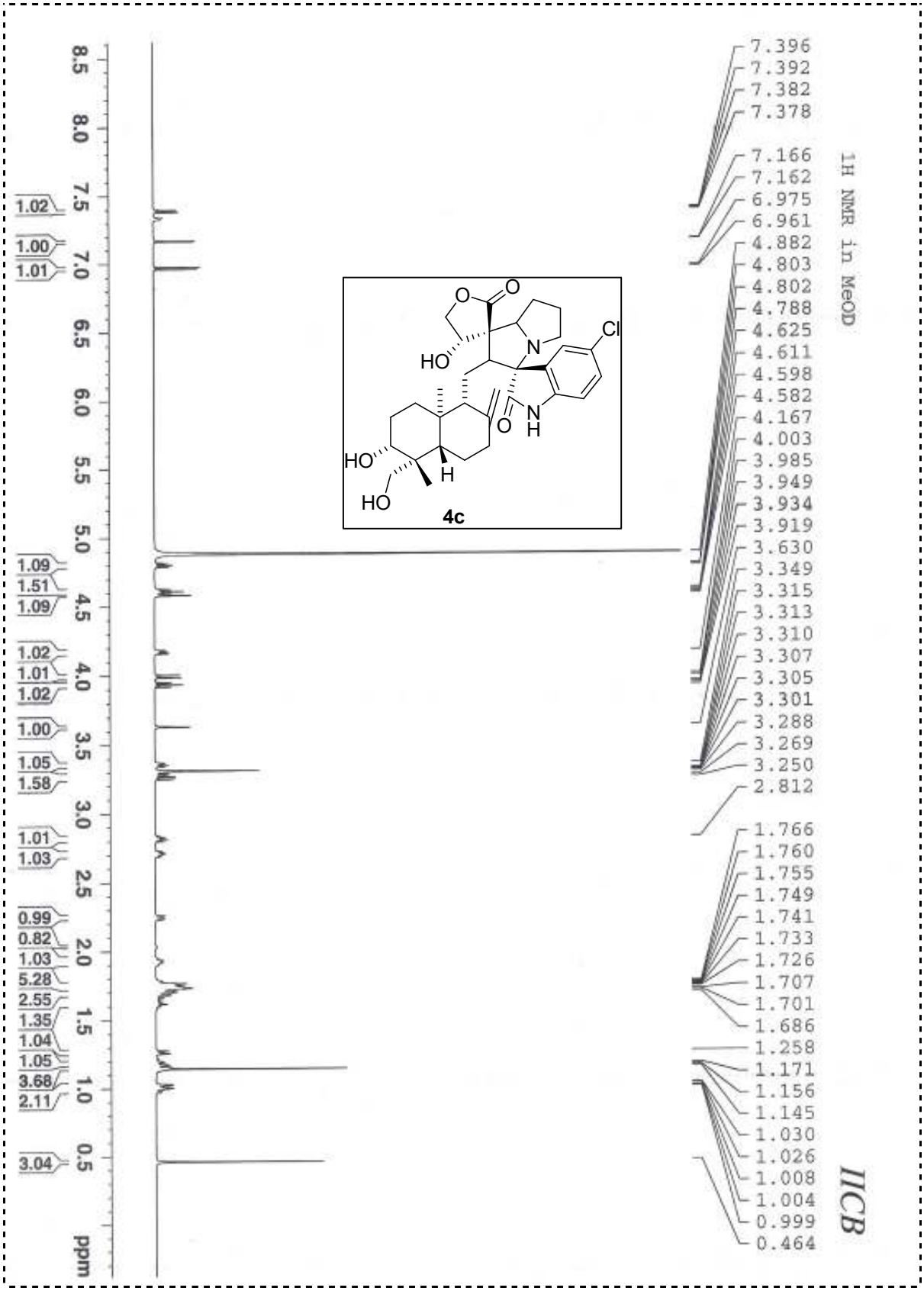

O
O
HO
N
N
H
O
HO
H
HO
4a

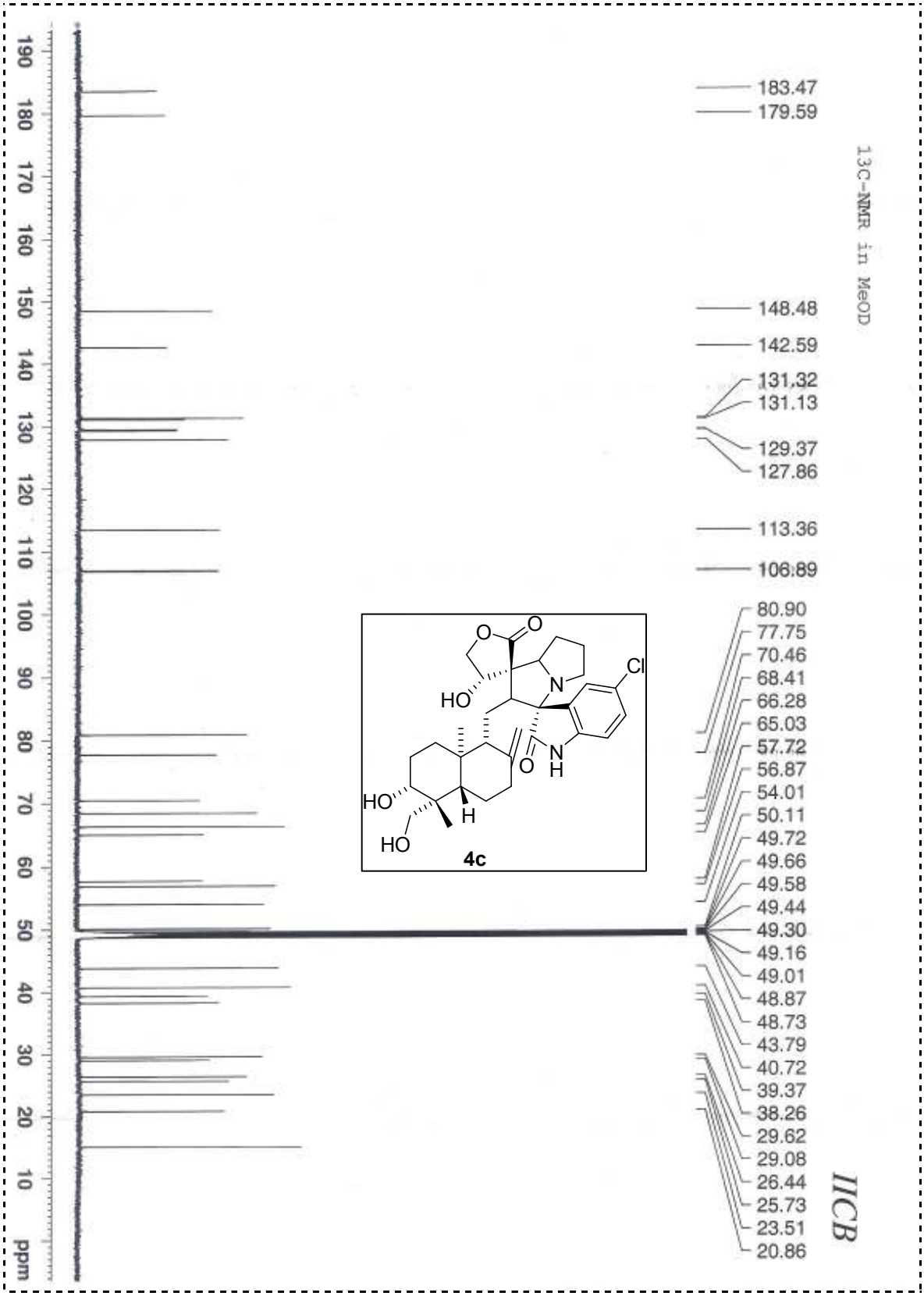

1H NMR in MeOD
IICB
4b
HO
HO
HO
O
O
N
H
N
H
ppm
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1.00
0.97
0.97
0.99
1.03
0.97
1.00
0.99
0.98
0.97
1.57
0.99
1.04
0.98
2.98
1.00
0.64
1.03
9.04
1.10
3.40
2.01
2.91
7.186
7.185
7.172
7.172
6.998
6.873
6.860
4.876
4.804
4.803
4.789
4.617
4.604
4.590
4.538
4.164
4.002
3.983
3.943
3.928
3.913
3.615
3.330
3.326
3.315
3.313
3.310
3.307
3.305
3.261
3.242
2.372
2.033
1.988
1.769
1.763
1.752
1.747
1.739
1.726
1.709
1.702
1.689
1.677
1.675
1.663
1.648
1.255
1.155
1.140
1.021
1.018
1.000
0.996
0.448

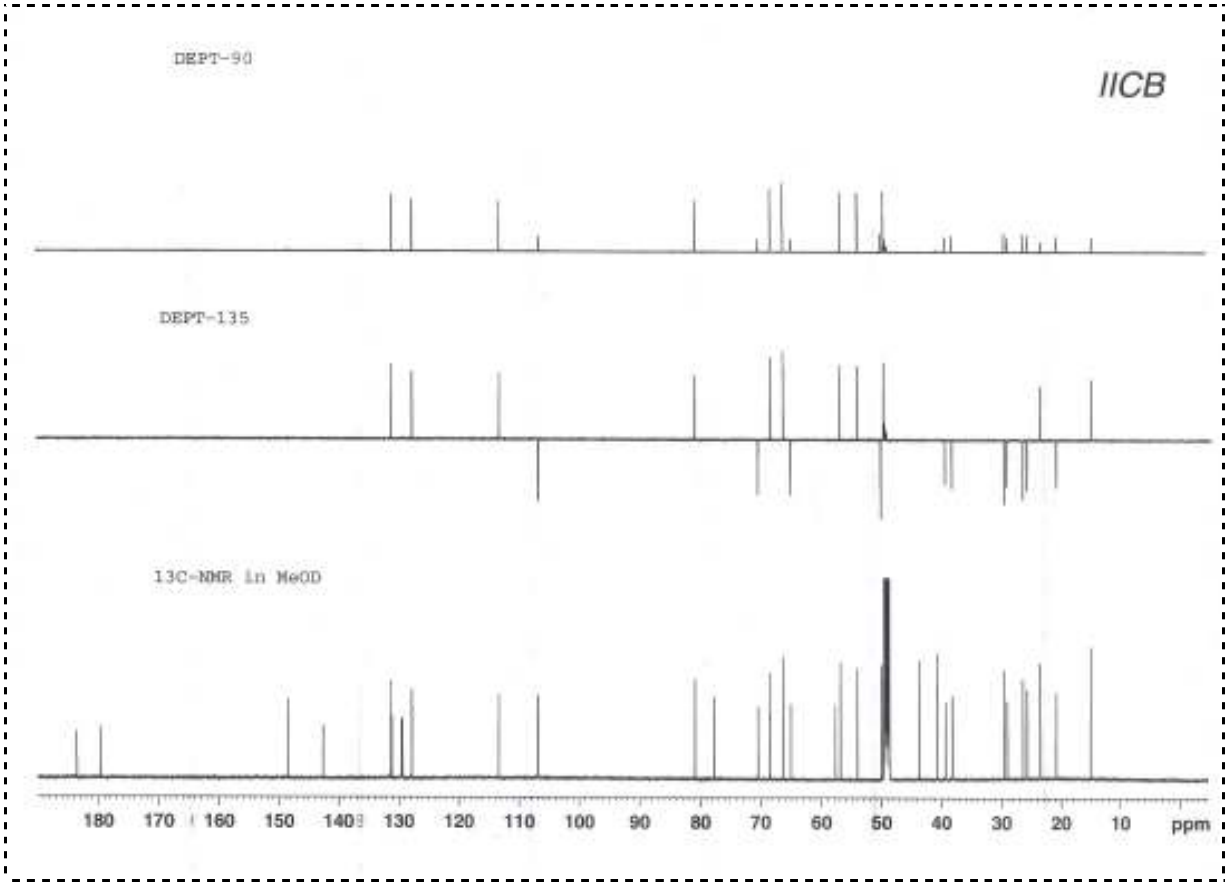

13C-NMR in MeOD
183.83
179.77
148.30
141.31
133.79
131.64
129.05
128.42
111.86
107.09
80.94
77.85
70.43
68.42
66.22
65.04
57.75
56.87
53.97
50.22
49.73
49.59
49.44
49.30
49.16
49.02
48.87
48.73
43.79
40.68
39.39
38.27
29.72
29.10
26.42
25.71
23.53
21.35
21.01
20.84
IICB
ppm
4b

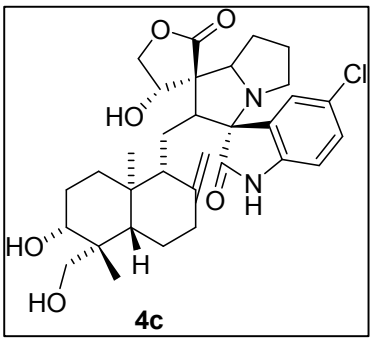

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

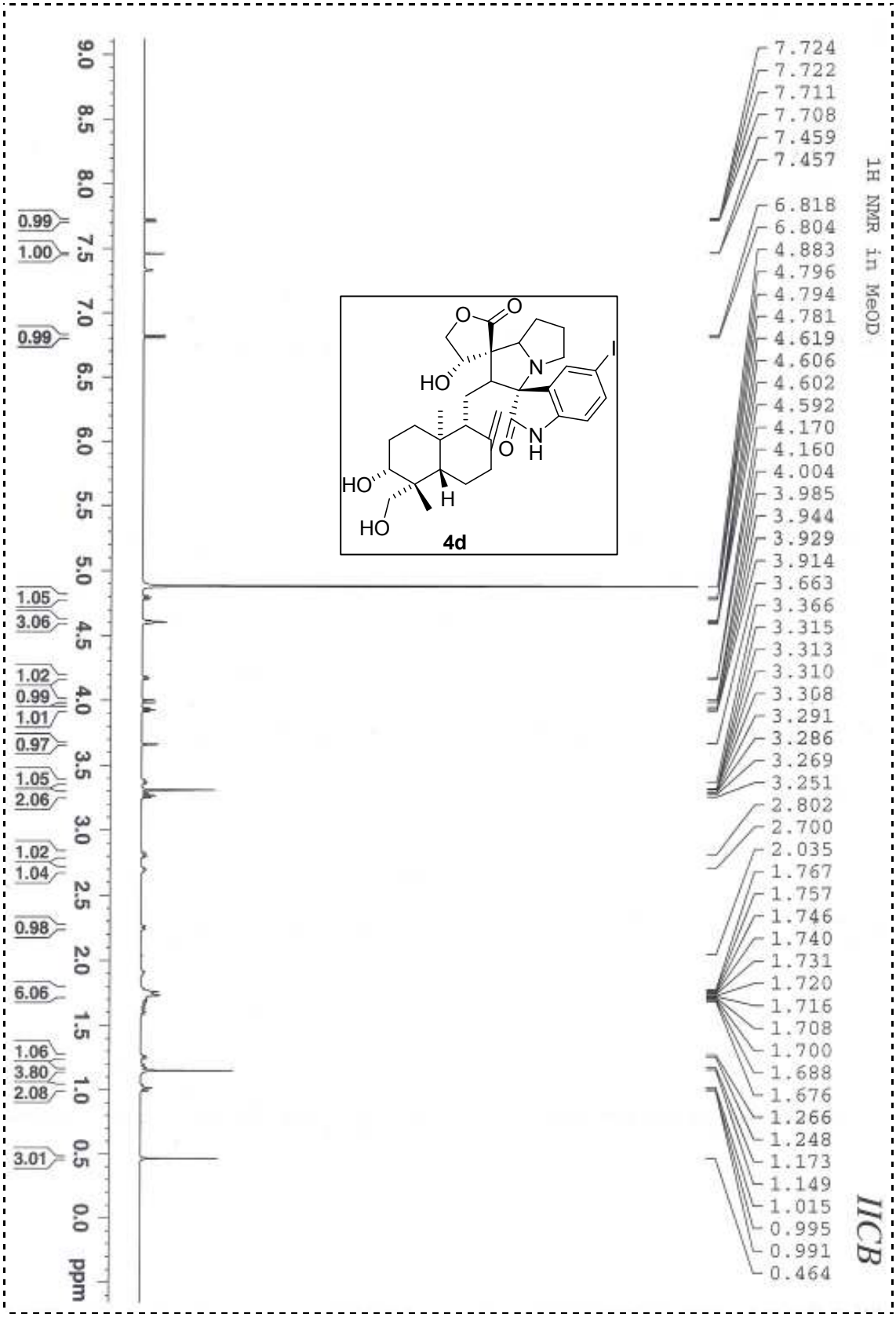

O
O
HO
N
N
H
O
HO
H
HO
4b

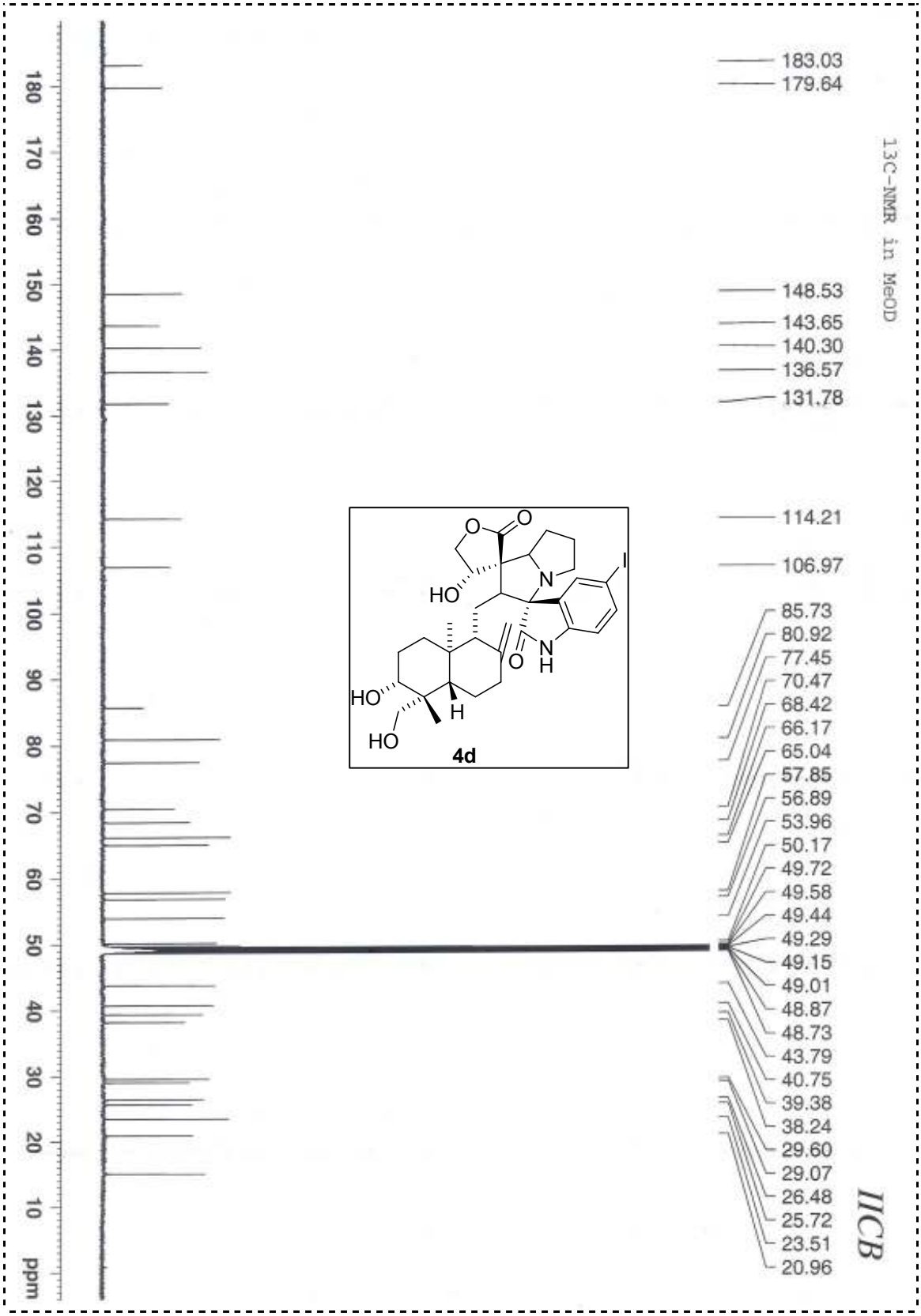

1H NMR in MeOD
7.396
7.392
7.382
7.378
7.166
7.162
6.975
6.961
4.882
4.803
4.802
4.788
4.625
4.611
4.598
4.582
4.167
4.003
3.985
3.949
3.934
3.919
3.630
3.349
3.315
3.313
3.310
3.307
3.305
3.301
3.288
3.269
3.250
2.812
1.766
1.760
1.755
1.749
1.741
1.733
1.726
1.707
1.701
1.686
1.258
1.171
1.156
1.145
1.030
1.026
1.008
1.004
0.999
0.464
IICB
4c
ppm

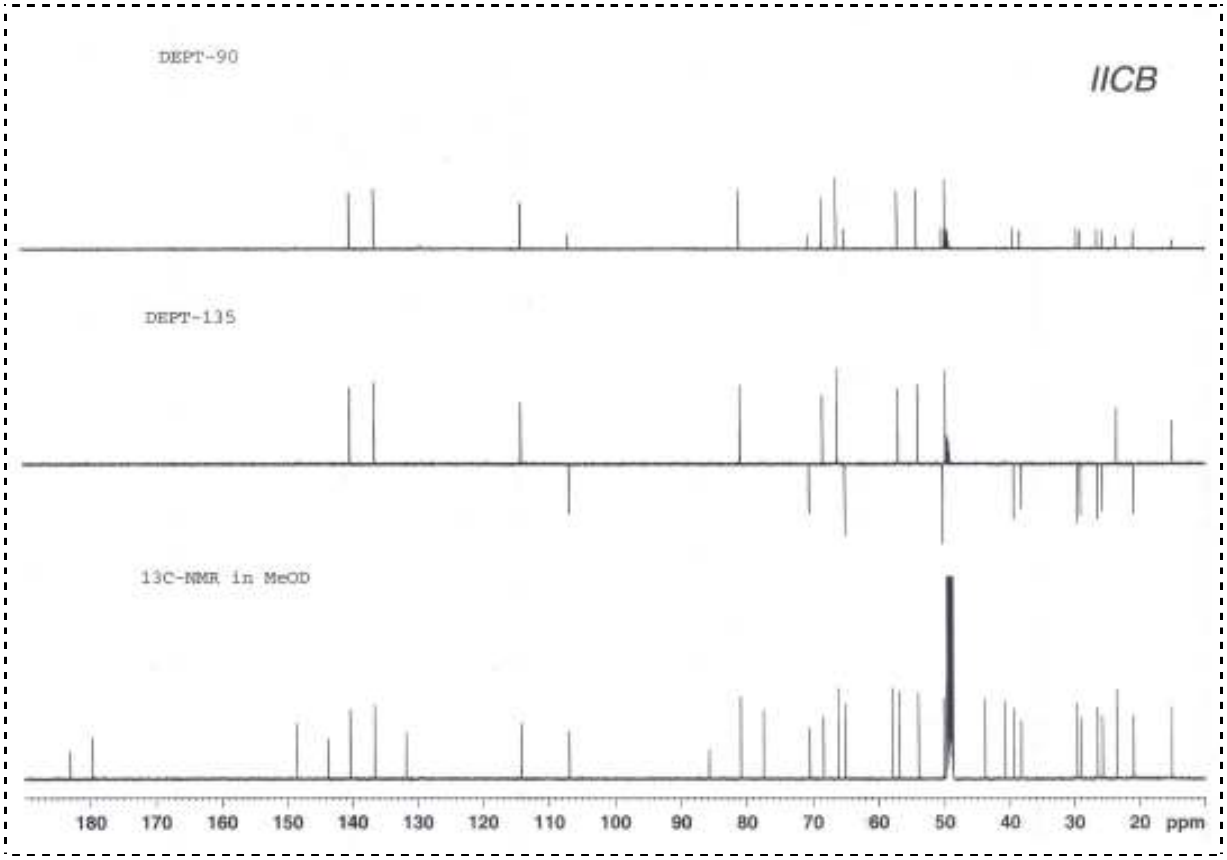

13C-NMR in MeOD
183.47
179.59
148.48
142.59
131.32
131.13
129.37
127.86
113.36
106.89
80.90
77.75
70.46
68.41
66.28
65.03
57.72
56.87
54.01
50.11
49.72
49.66
49.58
49.44
49.30
49.16
49.01
48.87
48.73
43.79
40.72
39.37
38.26
29.62
29.08
26.44
25.73
23.51
20.86
IICB
4c
ppm

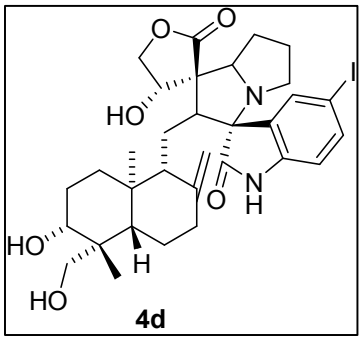

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

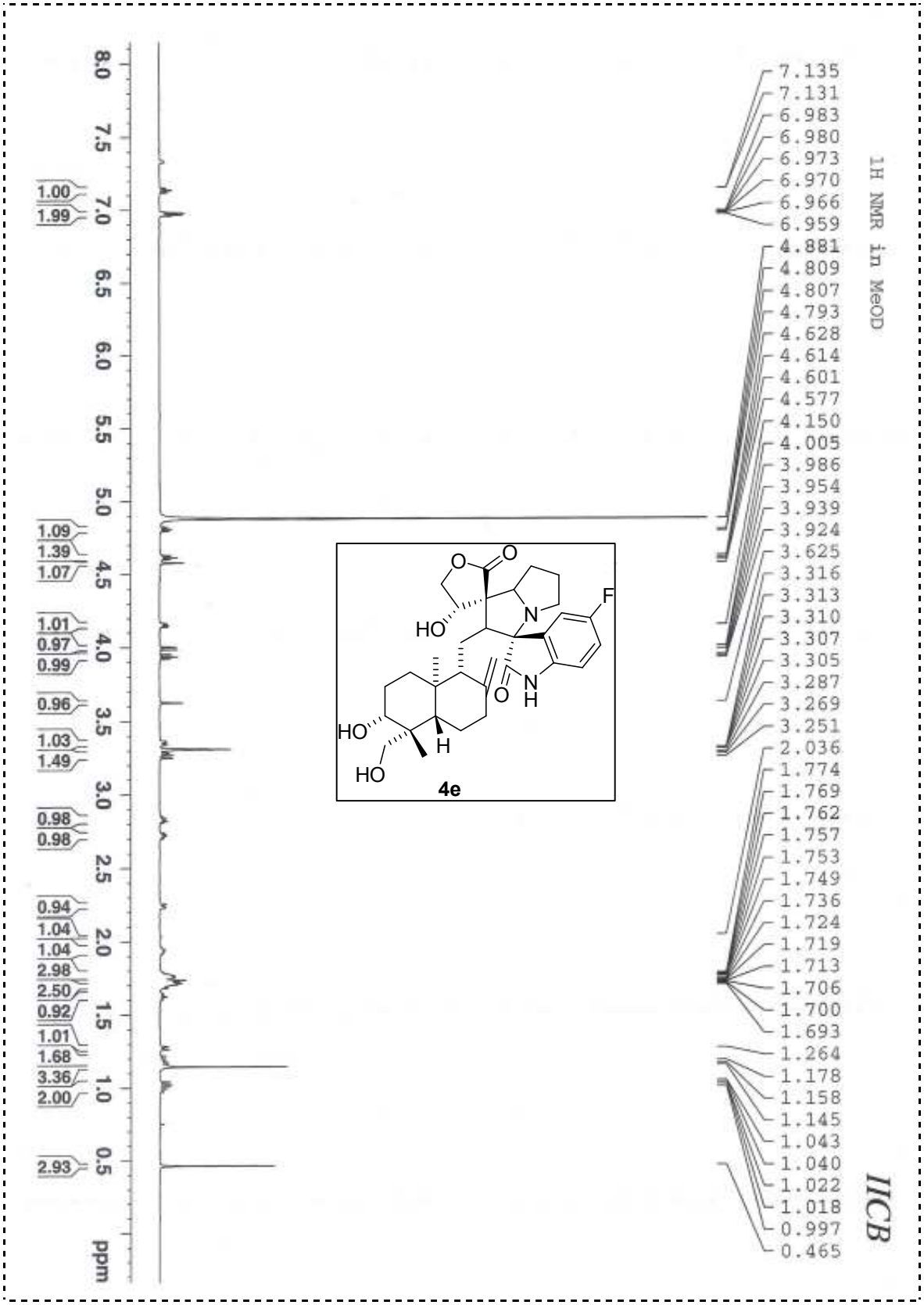

O
O
HO
N
Cl
N
H
O
HO
H
HO
4c

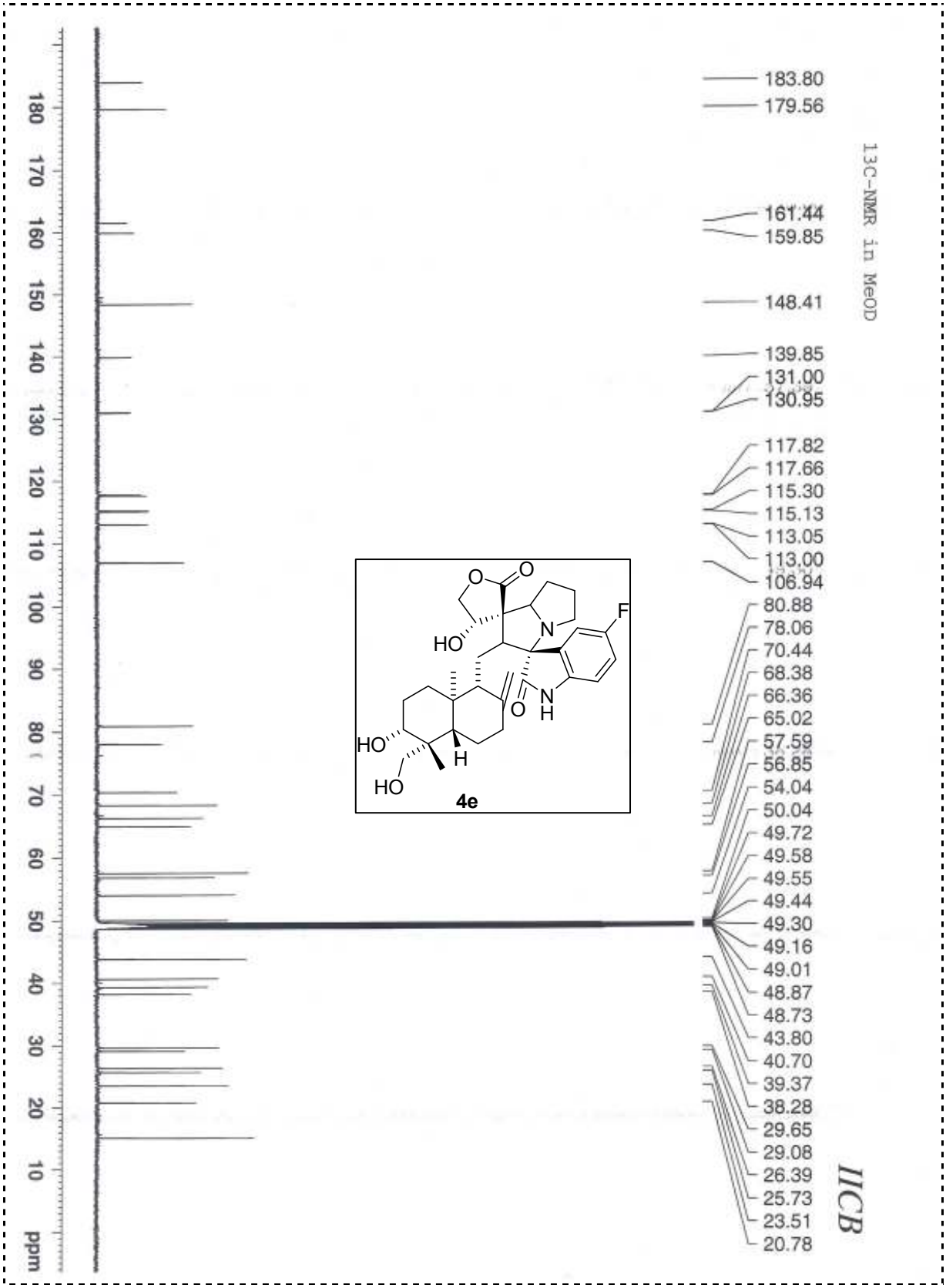

1H NMR in MeOD
IICB
4d
7.724
7.722
7.711
7.708
7.459
7.457
6.818
6.804
4.883
4.796
4.794
4.781
4.619
4.606
4.602
4.592
4.170
4.160
4.004
3.985
3.944
3.929
3.914
3.663
3.366
3.315
3.313
3.310
3.308
3.291
3.286
3.269
3.251
2.802
2.700
2.035
1.767
1.757
1.746
1.740
1.731
1.720
1.716
1.708
1.700
1.688
1.676
1.266
1.248
1.173
1.149
1.015
0.995
0.991
0.464
0.99
1.00
0.99
1.05
3.06
1.02
0.99
1.01
0.97
1.05
2.06
1.02
1.04
0.98
6.06
1.06
3.80
2.08
3.01
ppm

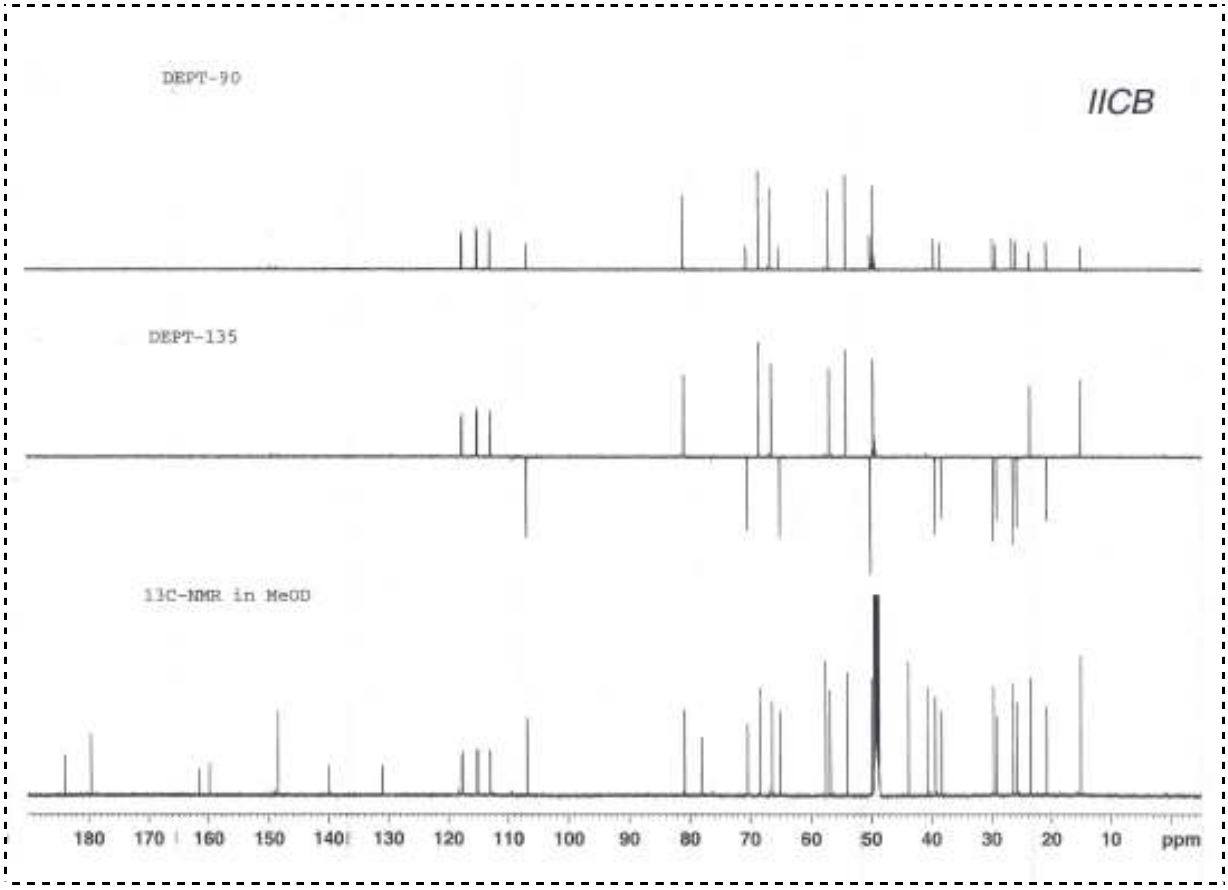

13C-NMR in MeOD
183.03
179.64
148.53
143.65
140.30
136.57
131.78
114.21
106.97
85.73
80.92
77.45
70.47
68.42
66.17
65.04
57.85
56.89
53.96
50.17
49.72
49.58
49.44
49.29
49.15
49.01
48.87
48.73
43.79
40.75
39.38
38.24
29.60
29.07
26.48
25.72
23.51
20.96
ppm
4d
IICB

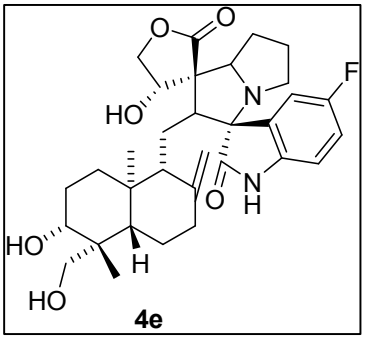

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
HO
N
I
N
H
O
HO
H
HO
4d

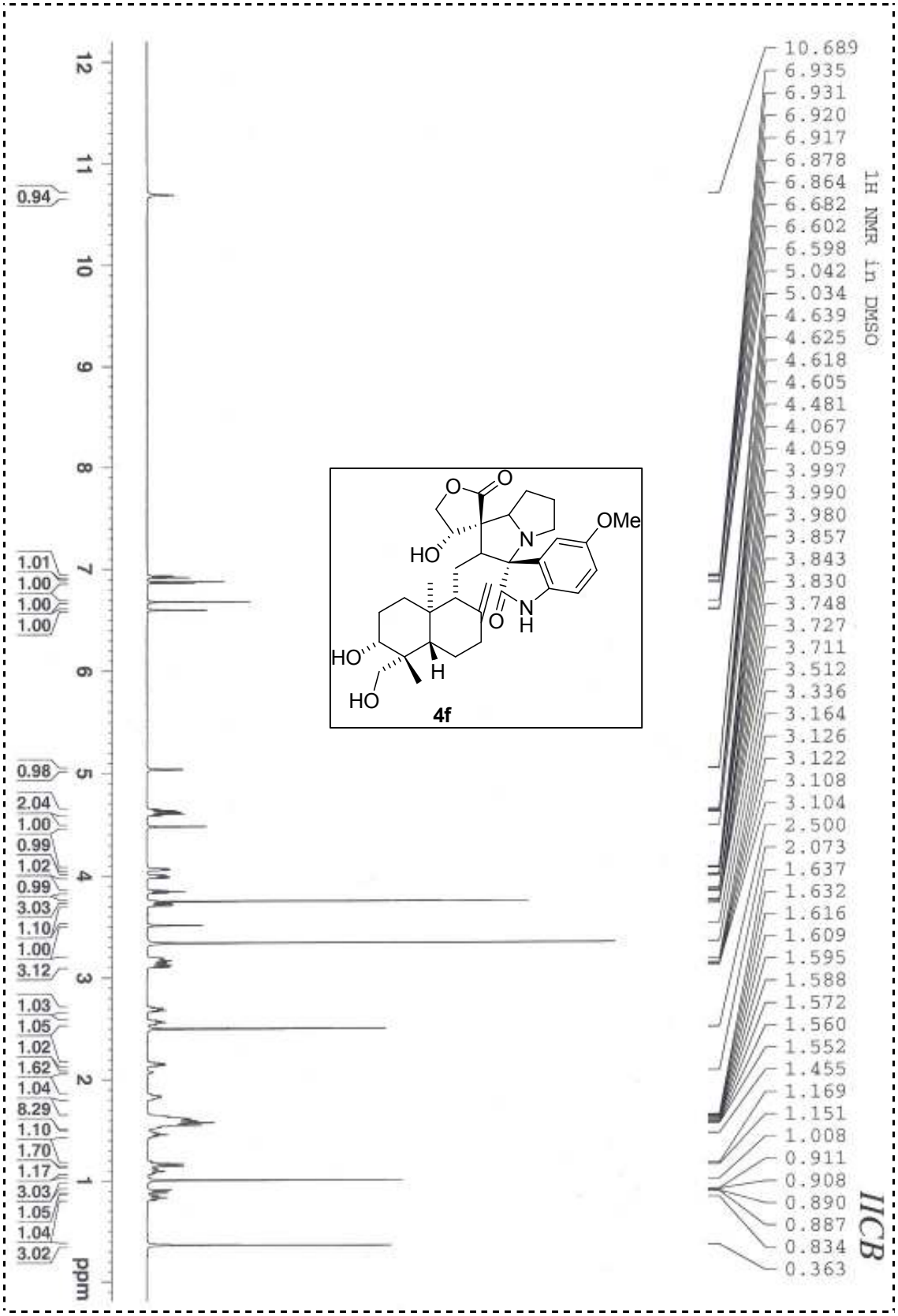

1H NMR in MeOD
7.135
7.131
6.983
6.980
6.973
6.970
6.966
6.959
4.881
4.809
4.807
4.793
4.628
4.614
4.601
4.577
4.150
4.005
3.986
3.954
3.939
3.924
3.625
3.316
3.313
3.310
3.307
3.305
3.287
3.269
3.251
2.036
1.774
1.769
1.762
1.757
1.753
1.749
1.736
1.724
1.719
1.713
1.706
1.700
1.693
1.264
1.178
1.158
1.145
1.043
1.040
1.022
1.018
0.997
0.465
IICB
4e
ppm

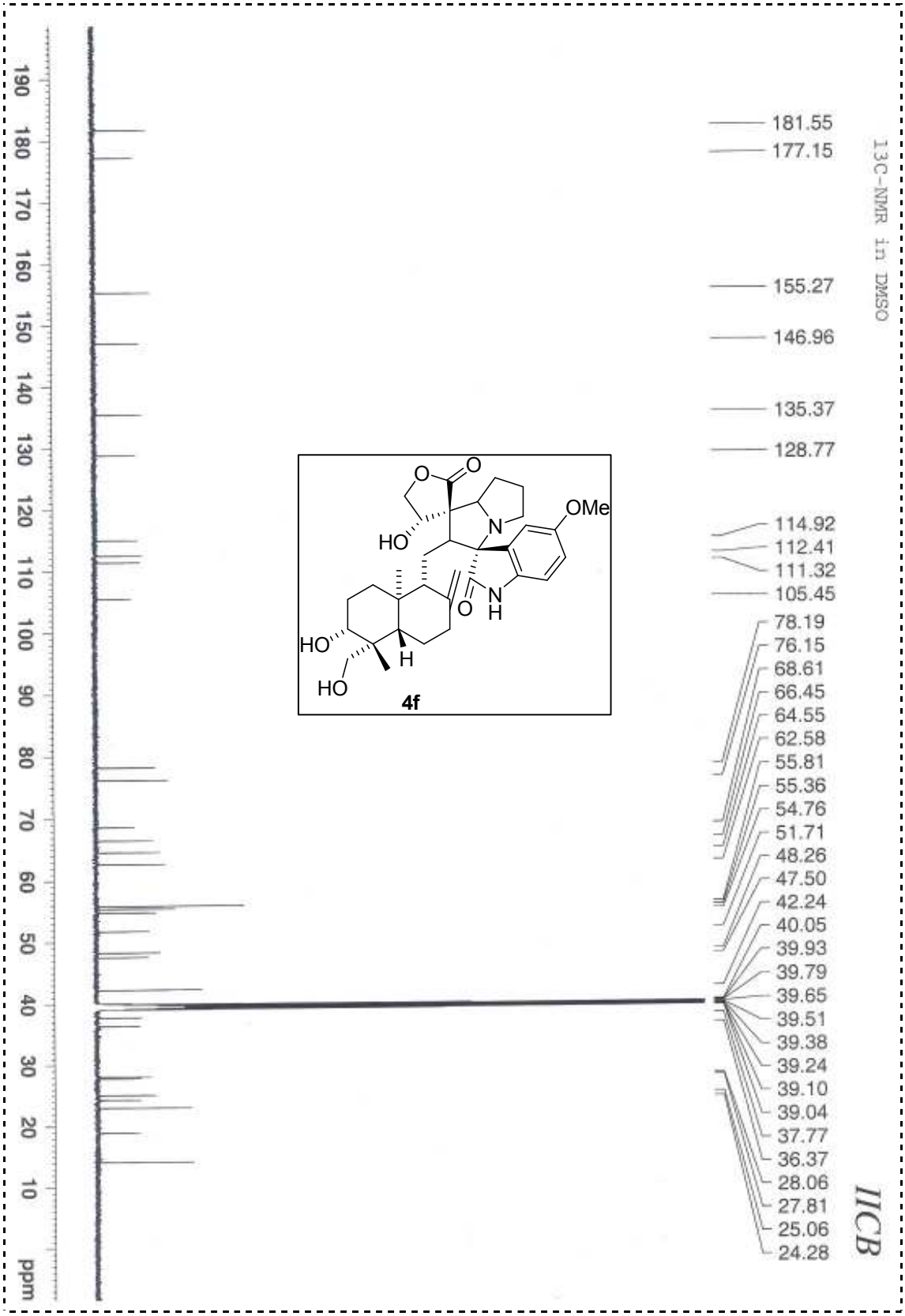

13C-NMR in MeOD
183.80
179.56
161.44
159.85
148.41
139.85
131.00
130.95
117.82
117.66
115.30
115.13
113.05
113.00
106.94
80.88
78.06
70.44
68.38
66.36
65.02
57.59
56.85
54.04
50.04
49.72
49.58
49.55
49.44
49.30
49.16
49.01
48.87
48.73
43.80
40.70
39.37
38.28
29.65
29.08
26.39
25.73
23.51
20.78
IICB
ppm
4e

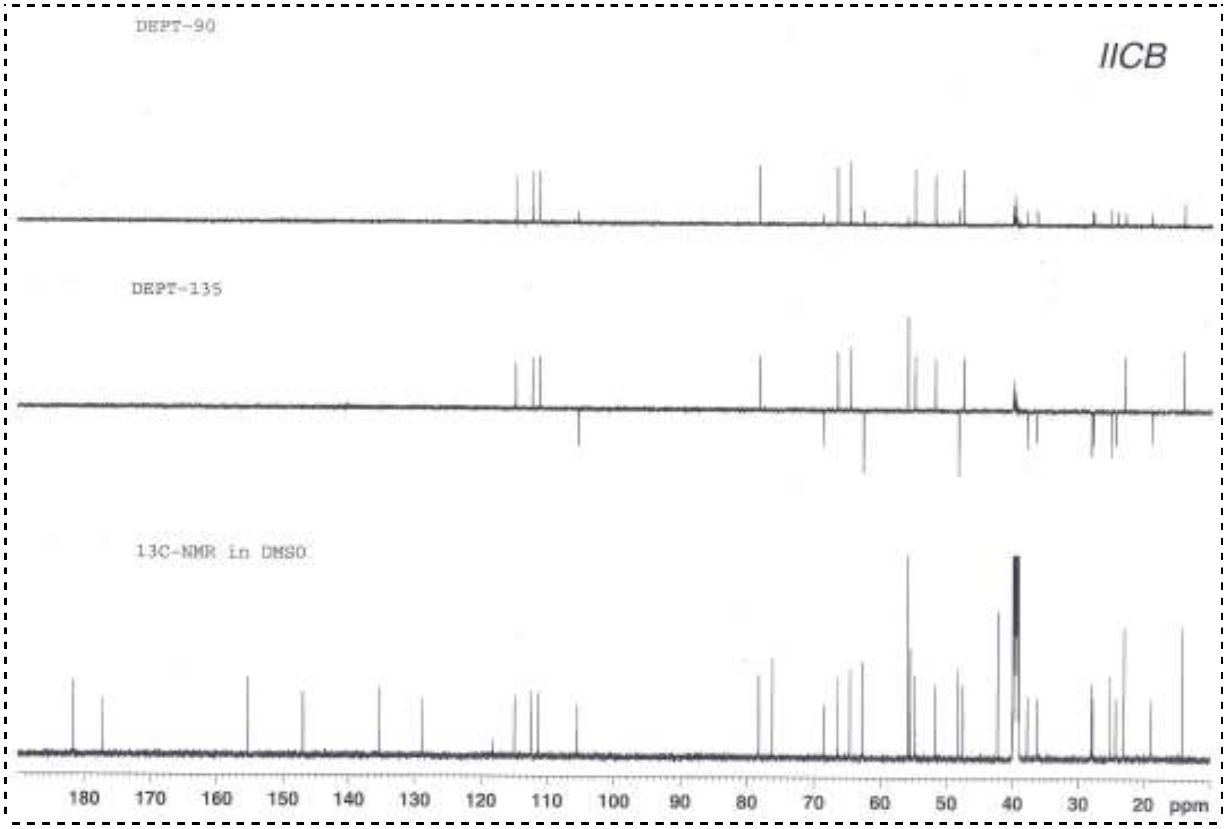

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

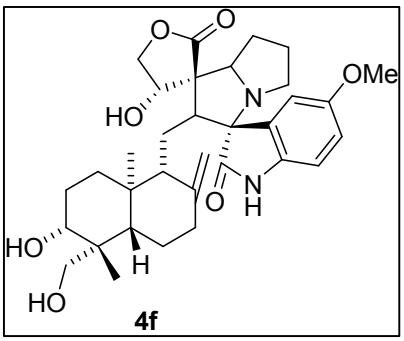

O
O
F
N
HO
N
H
O
HO
H
HO

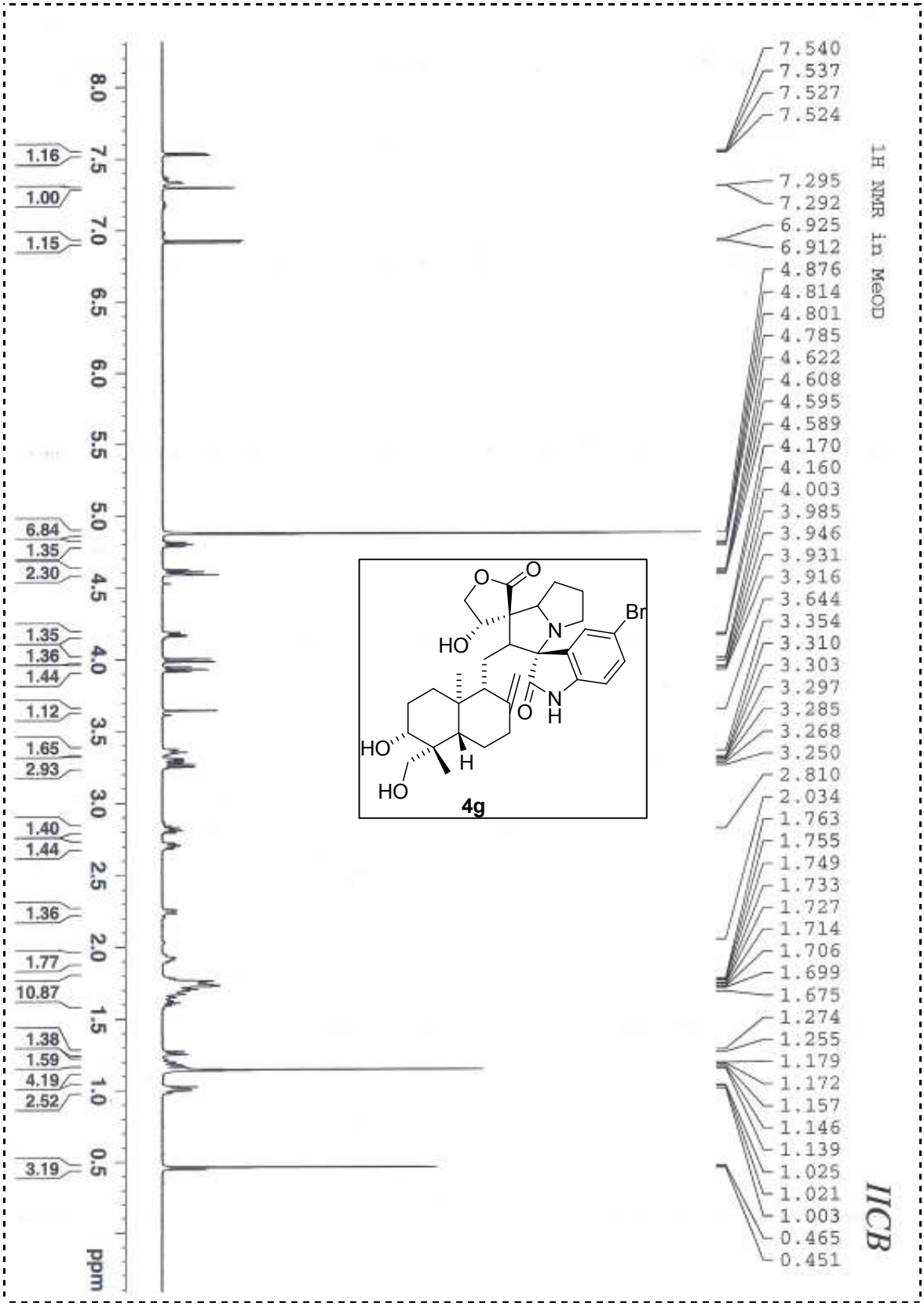
4e

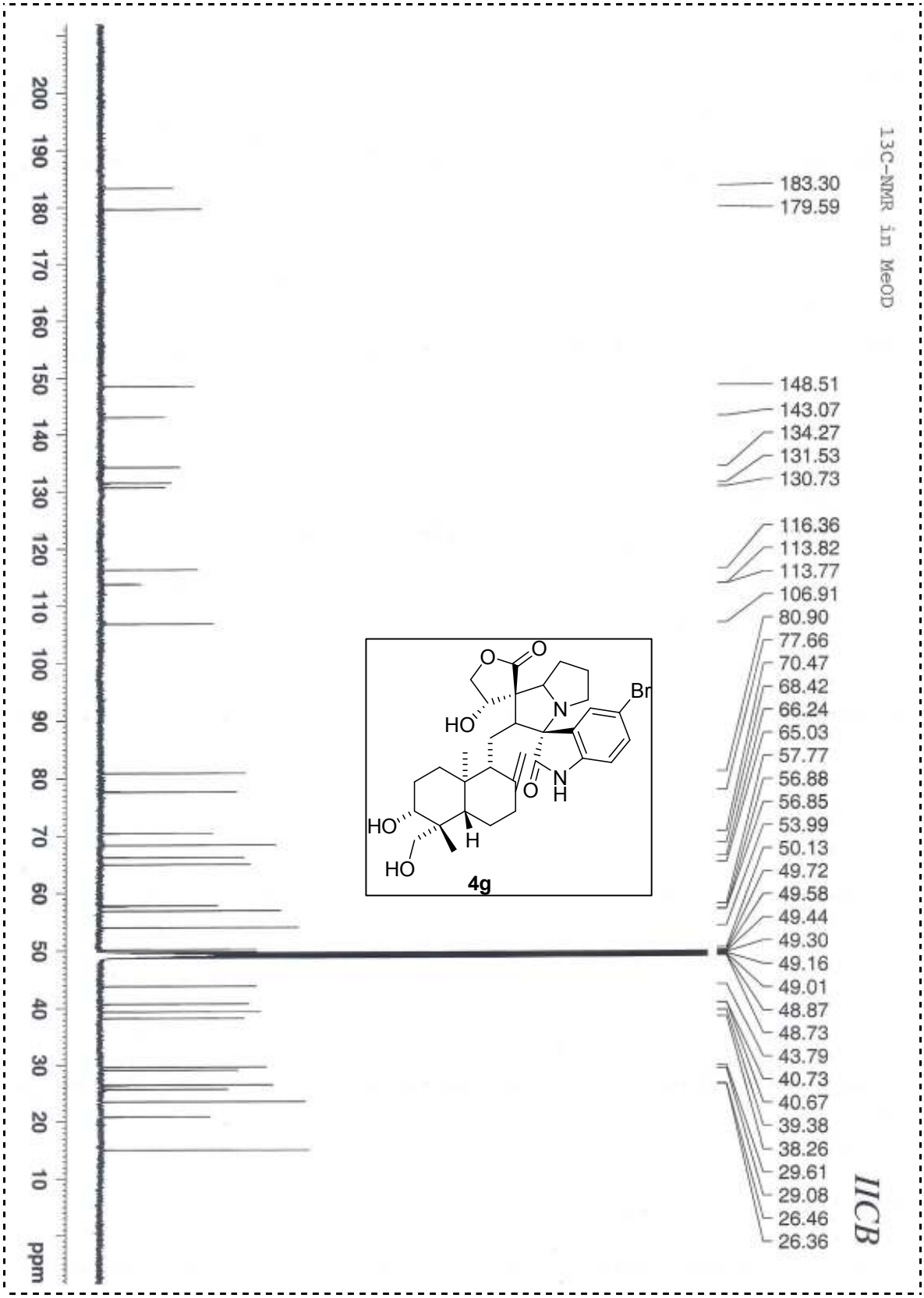

1H NMR in DMSO
IICB
4f
OMe
HO
HO
HO
N
N
H
O
O
O
H
ppm
12
11
10
9
8
7
6
5
4
3
2
1
0.94
1.01
1.00
1.00
1.00
0.98
2.04
1.00
0.99
1.02
0.99
3.03
1.10
1.00
3.12
1.03
1.05
1.02
1.62
1.04
8.29
1.10
1.70
1.17
3.03
1.05
1.04
3.02
10.689
6.935
6.931
6.920
6.917
6.878
6.864
6.682
6.602
6.598
5.042
5.034
4.639
4.625
4.618
4.605
4.481
4.067
4.059
3.997
3.990
3.980
3.857
3.843
3.830
3.748
3.727
3.711
3.512
3.336
3.164
3.126
3.122
3.108
3.104
2.500
2.073
1.637
1.632
1.616
1.609
1.595
1.588
1.572
1.560
1.552
1.455
1.169
1.151
1.008
0.911
0.908
0.890
0.887
0.834
0.363

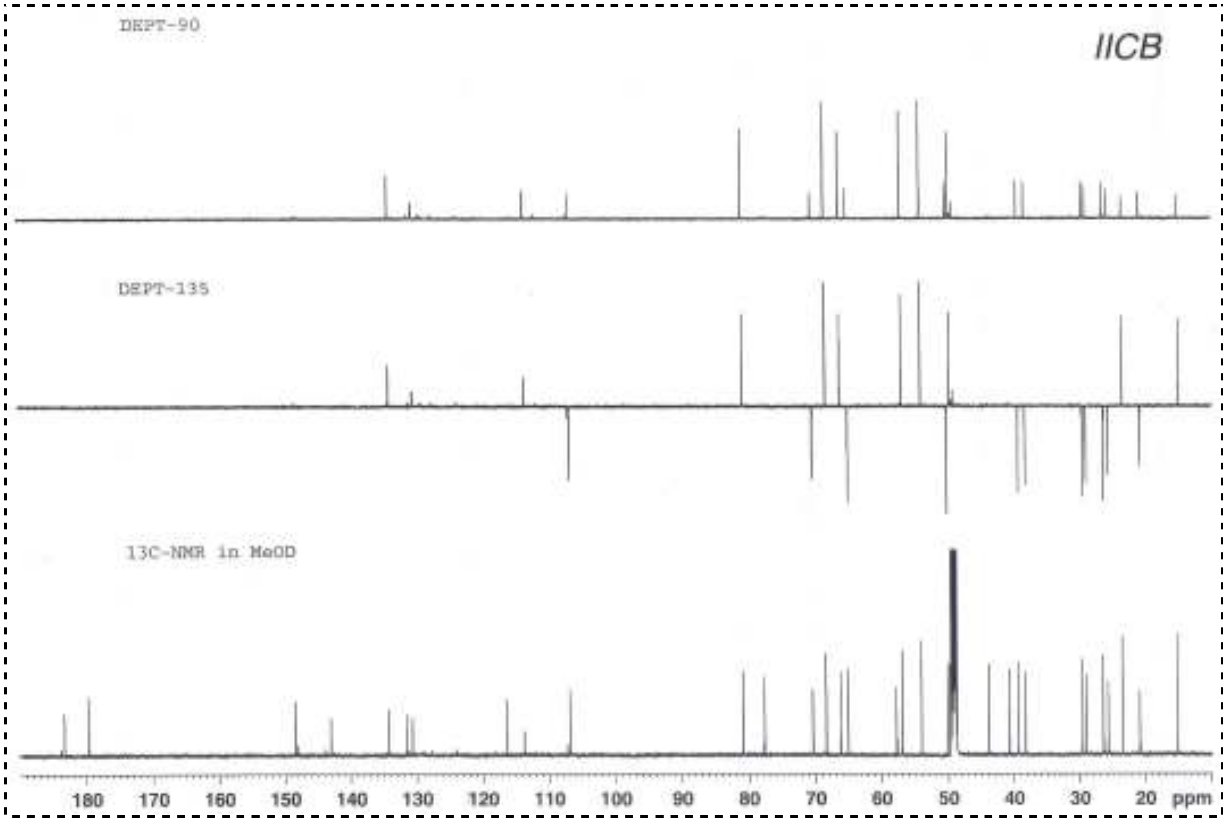

13C-NMR in DMSO
181.55
177.15
155.27
146.96
135.37
128.77
114.92
112.41
111.32
105.45
78.19
76.15
68.61
66.45
64.55
62.58
55.81
55.36
54.76
51.71
48.26
47.50
42.24
40.05
39.93
39.79
39.65
39.51
39.38
39.24
39.10
39.04
37.77
36.37
28.06
27.81
25.06
24.28
IICB
ppm
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
OMe
N
HO
O
N
H
HO
H
HO
4f

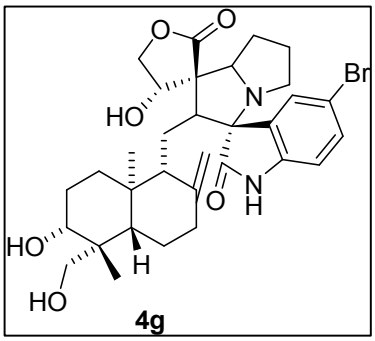

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
OMe
N
HO
O
N
H
HO
H
HO
4f

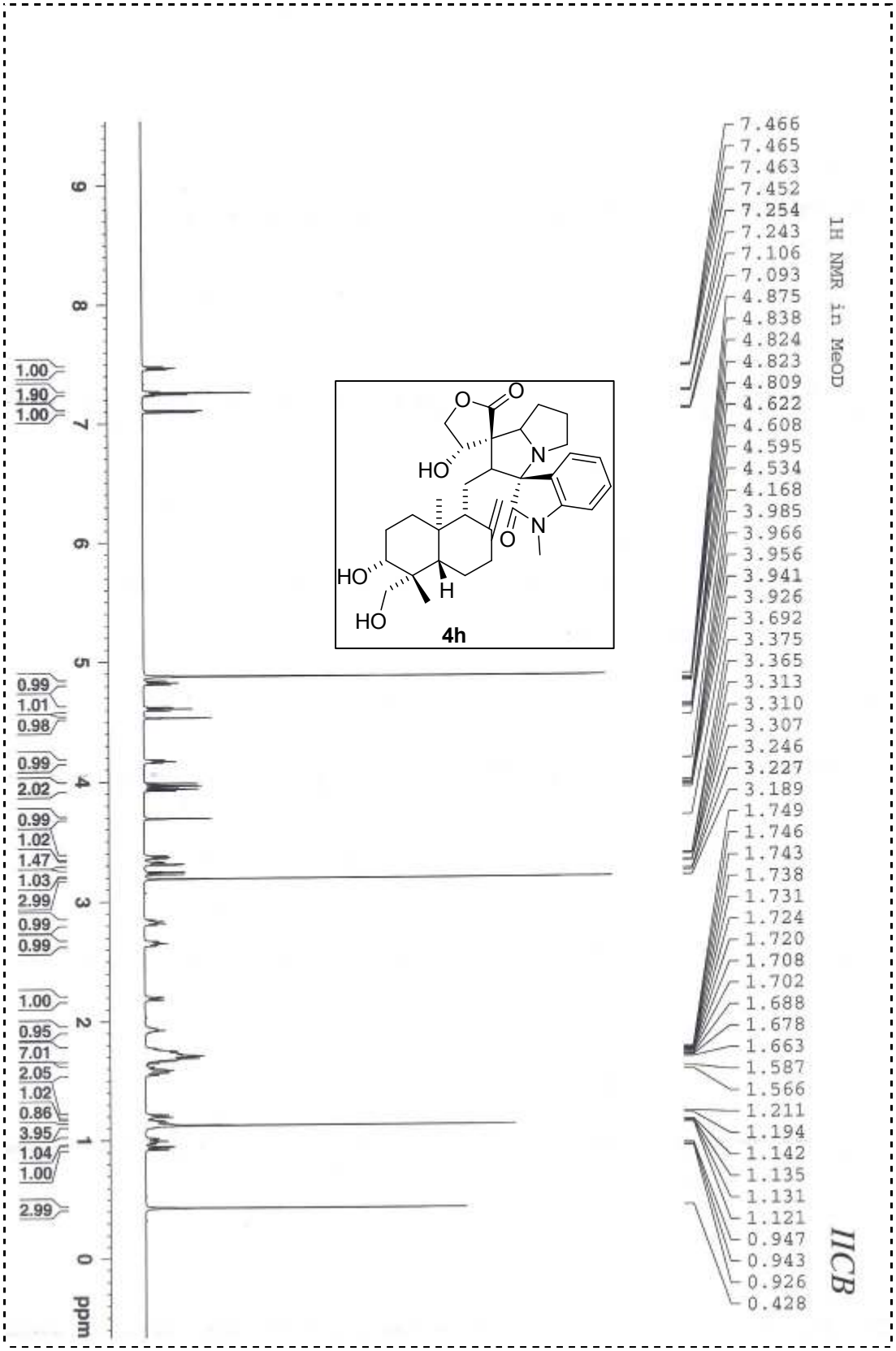

1H NMR in MeOD
IICB
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1.16
1.00
1.15
6.84
1.35
2.30
1.35
1.36
1.44
1.12
1.65
2.93
1.40
1.44
1.36
1.77
10.87
1.38
1.59
4.19
2.52
3.19
7.540
7.537
7.527
7.524
7.295
7.292
6.925
6.912
4.876
4.814
4.801
4.785
4.622
4.608
4.595
4.589
4.170
4.160
4.003
3.985
3.946
3.931
3.916
3.644
3.354
3.310
3.303
3.297
3.285
3.268
3.250
2.810
2.034
1.763
1.755
1.749
1.733
1.727
1.714
1.706
1.699
1.675
1.274
1.255
1.179
1.172
1.157
1.146
1.139
1.025
1.021
1.003
0.465
0.451
O
O
HO
N
Br
N
H
O
HO
H
HO
4g

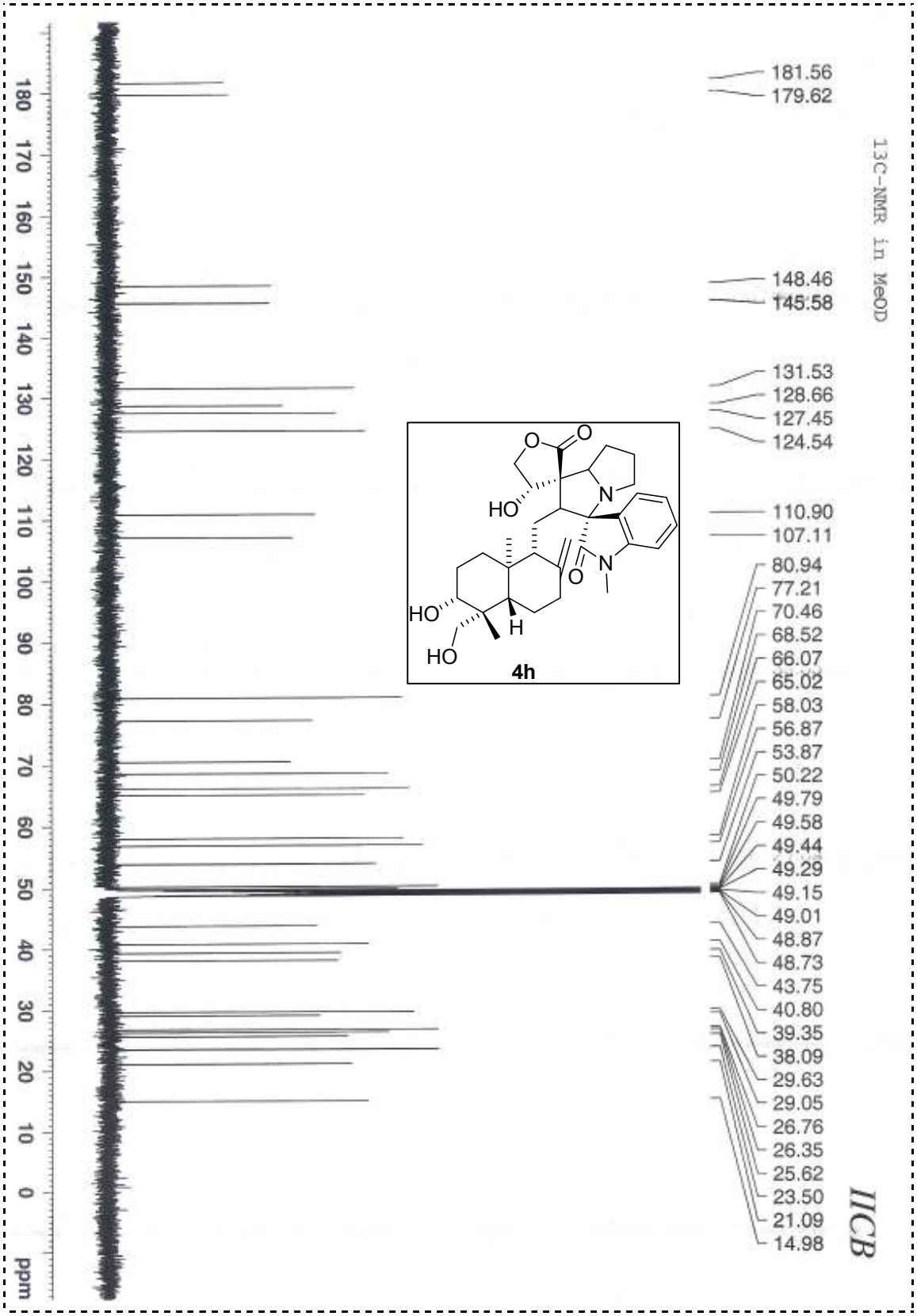

13C-NMR in MeOD
183.30
179.59
148.51
143.07
134.27
131.53
130.73
116.36
113.82
113.77
106.91
80.90
77.66
70.47
68.42
66.24
65.03
57.77
56.88
56.85
53.99
50.13
49.72
49.58
49.44
49.30
49.16
49.01
48.87
48.73
43.79
40.73
40.67
39.38
38.26
29.61
29.08
26.46
26.36
IICB
ppm
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
O
O
HO
N
Br
O
N
H
HO
H
HO
4g

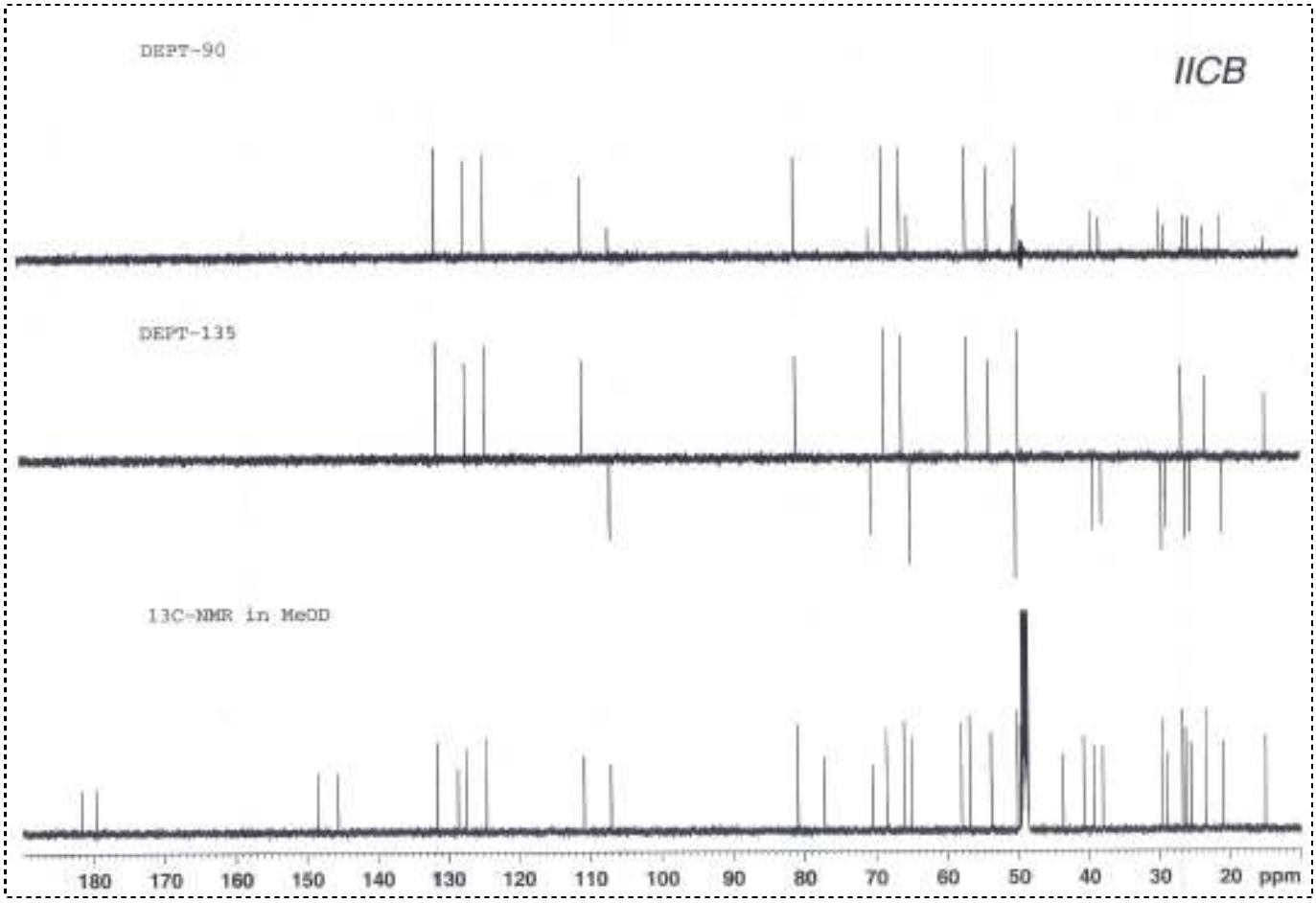

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

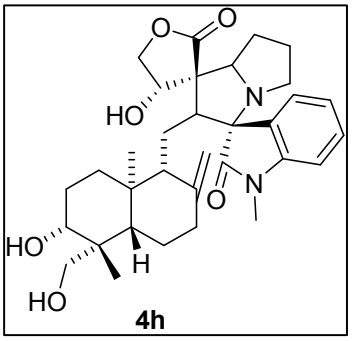

O
O
Br
N
HO
N
H
O
HO
H
HO

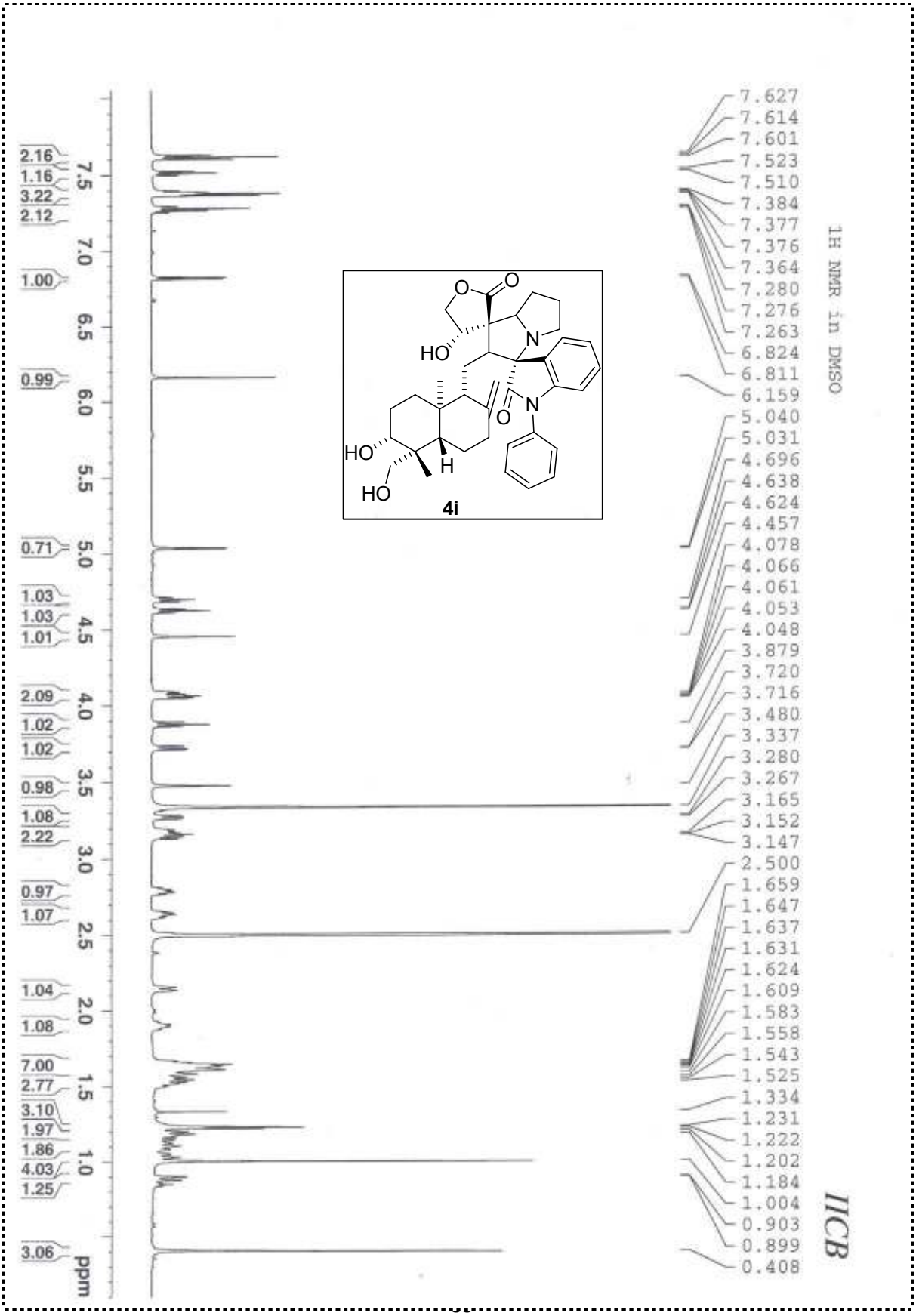
4g

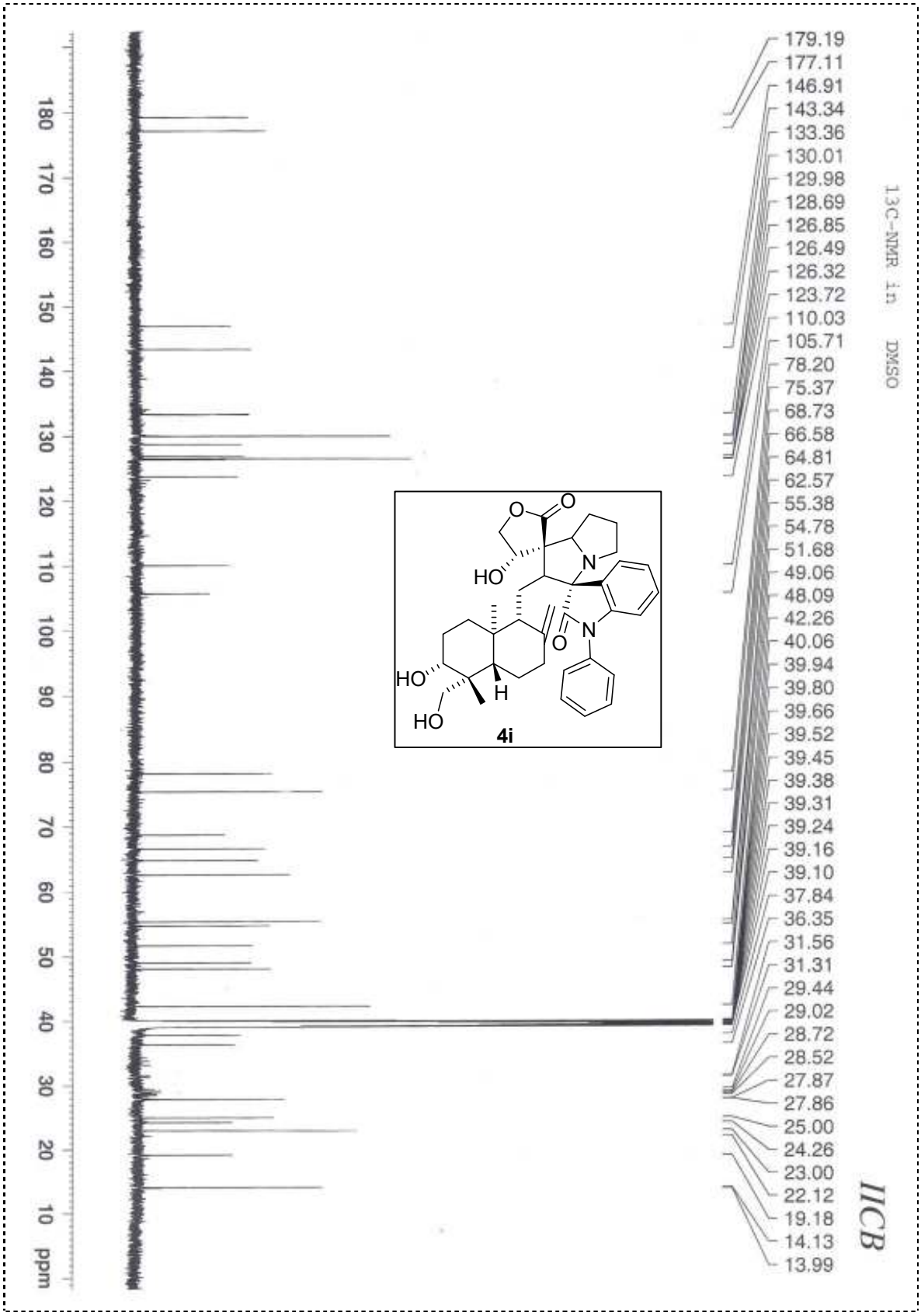

1H NMR in MeOD
IICB
4h
HO
HO
HO
O
O
N
N
O
H
7.466
7.465
7.463
7.452
7.254
7.243
7.106
7.093
4.875
4.838
4.824
4.823
4.809
4.622
4.608
4.595
4.534
4.168
3.985
3.966
3.956
3.941
3.926
3.692
3.375
3.365
3.313
3.310
3.307
3.246
3.227
3.189
1.749
1.746
1.743
1.738
1.731
1.724
1.720
1.708
1.702
1.688
1.678
1.663
1.587
1.566
1.211
1.194
1.142
1.135
1.131
1.121
0.947
0.943
0.926
0.428
1.00
1.90
1.00
0.99
1.01
0.98
0.99
2.02
0.99
1.02
1.47
1.03
2.99
0.99
0.99
1.00
0.95
7.01
2.05
1.02
0.86
3.95
1.04
1.00
2.99
ppm

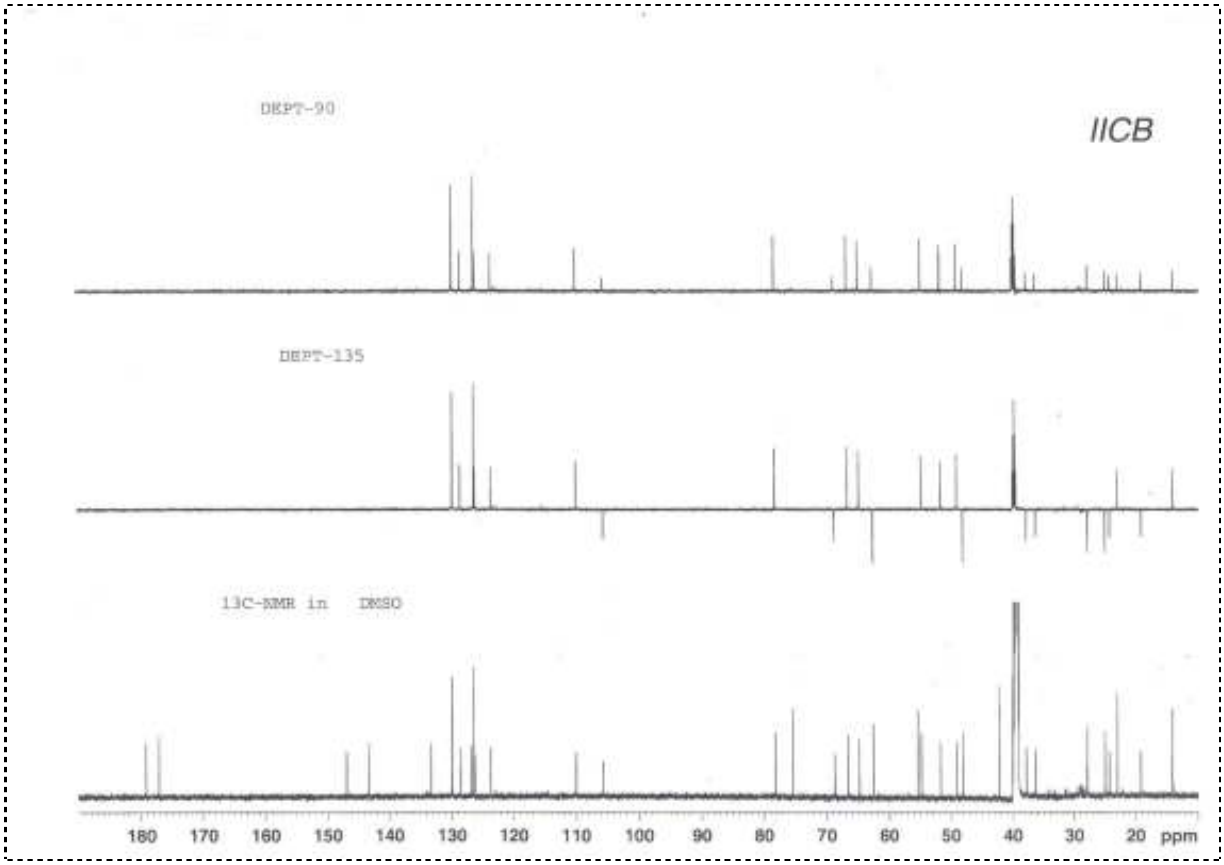

13C-NMR in MeOD
181.56
179.62
148.46
145.58
131.53
128.66
127.45
124.54
110.90
107.11
80.94
77.21
70.46
68.52
66.07
65.02
58.03
56.87
53.87
50.22
49.79
49.58
49.44
49.29
49.15
49.01
48.87
48.73
43.75
40.80
39.35
38.09
29.63
29.05
26.76
26.35
25.62
23.50
21.09
14.98
IICB
4h
ppm

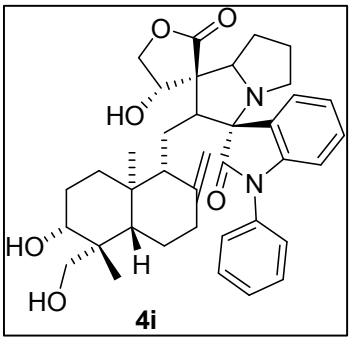

DEPT-90
IICB
DEPT-135
13C-NMR in MeOD
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

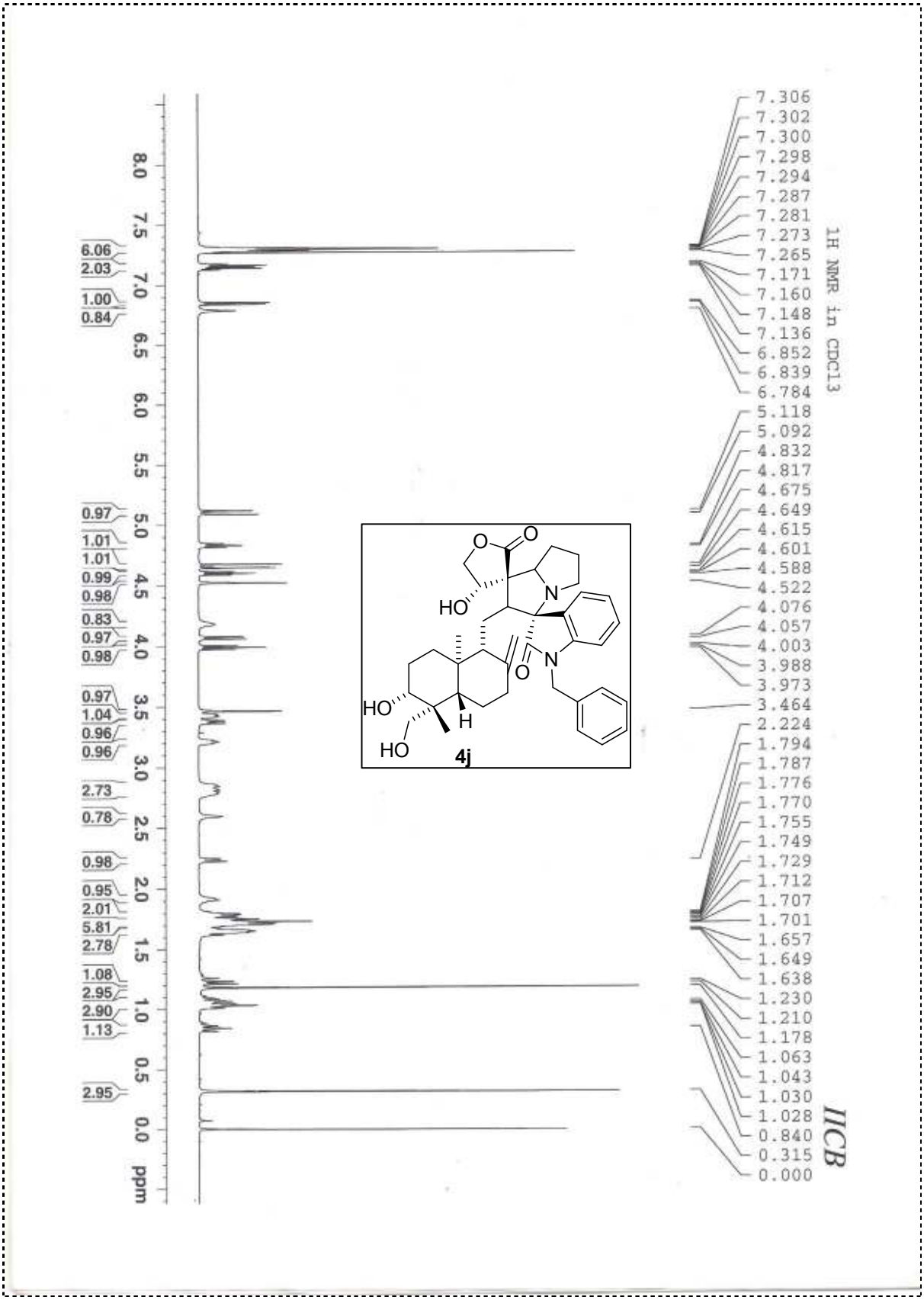

O
O
HO
N
N
O
HO
H
HO
4h

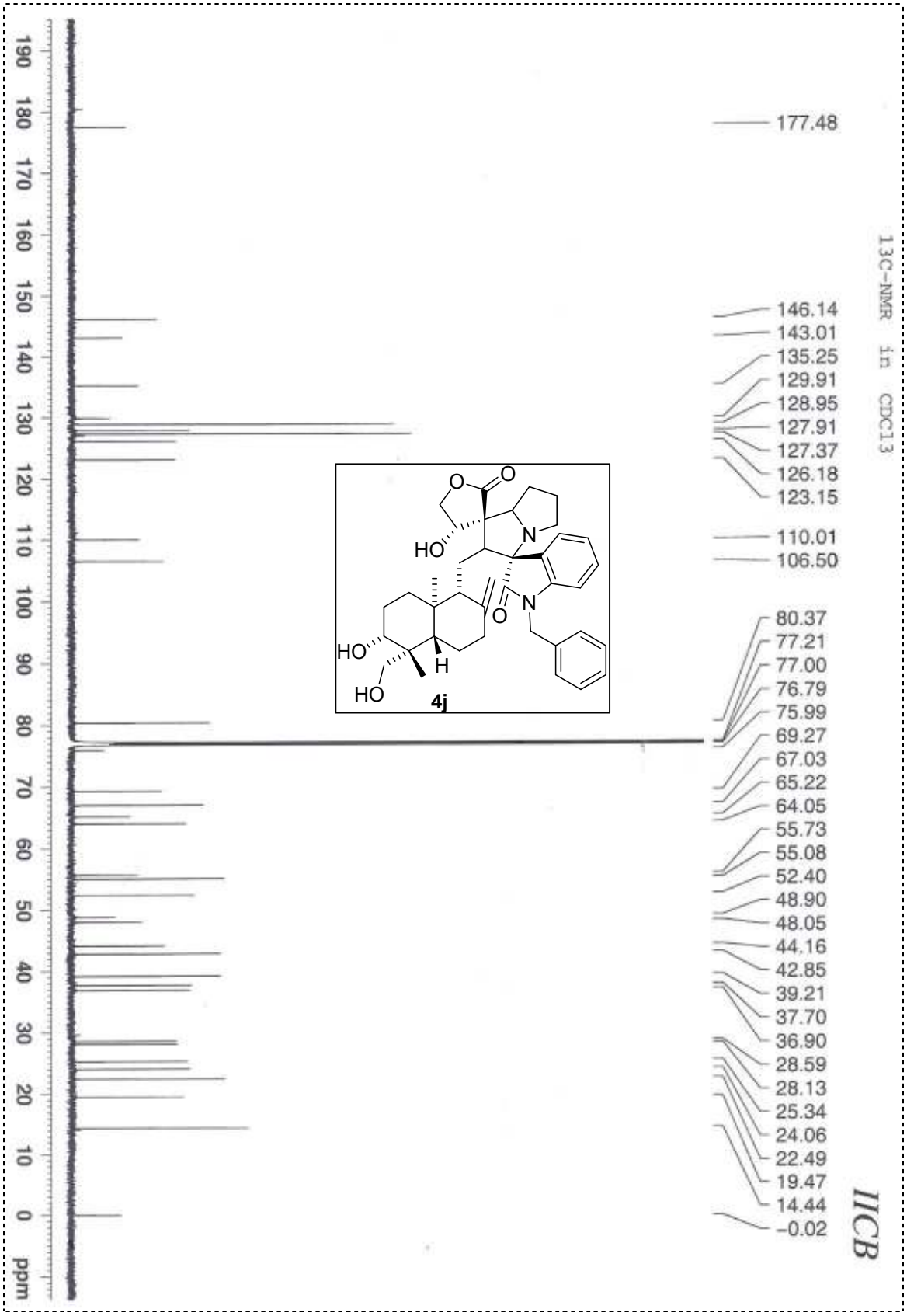

1H NMR in DMSO
IICB
4i
7.627
7.614
7.601
7.523
7.510
7.384
7.377
7.376
7.364
7.280
7.276
7.263
6.824
6.811
6.159
5.040
5.031
4.696
4.638
4.624
4.457
4.078
4.066
4.061
4.053
4.048
3.879
3.720
3.716
3.480
3.337
3.280
3.267
3.165
3.152
3.147
2.500
1.659
1.647
1.637
1.631
1.624
1.609
1.583
1.558
1.543
1.525
1.334
1.231
1.222
1.202
1.184
1.004
0.903
0.899
0.408
2.16
1.16
3.22
2.12
1.00
0.99
0.71
1.03
1.03
1.01
2.09
1.02
1.02
0.98
1.08
2.22
0.97
1.07
1.04
1.08
7.00
2.77
3.10
1.97
1.86
4.03
1.25
3.06
ppm

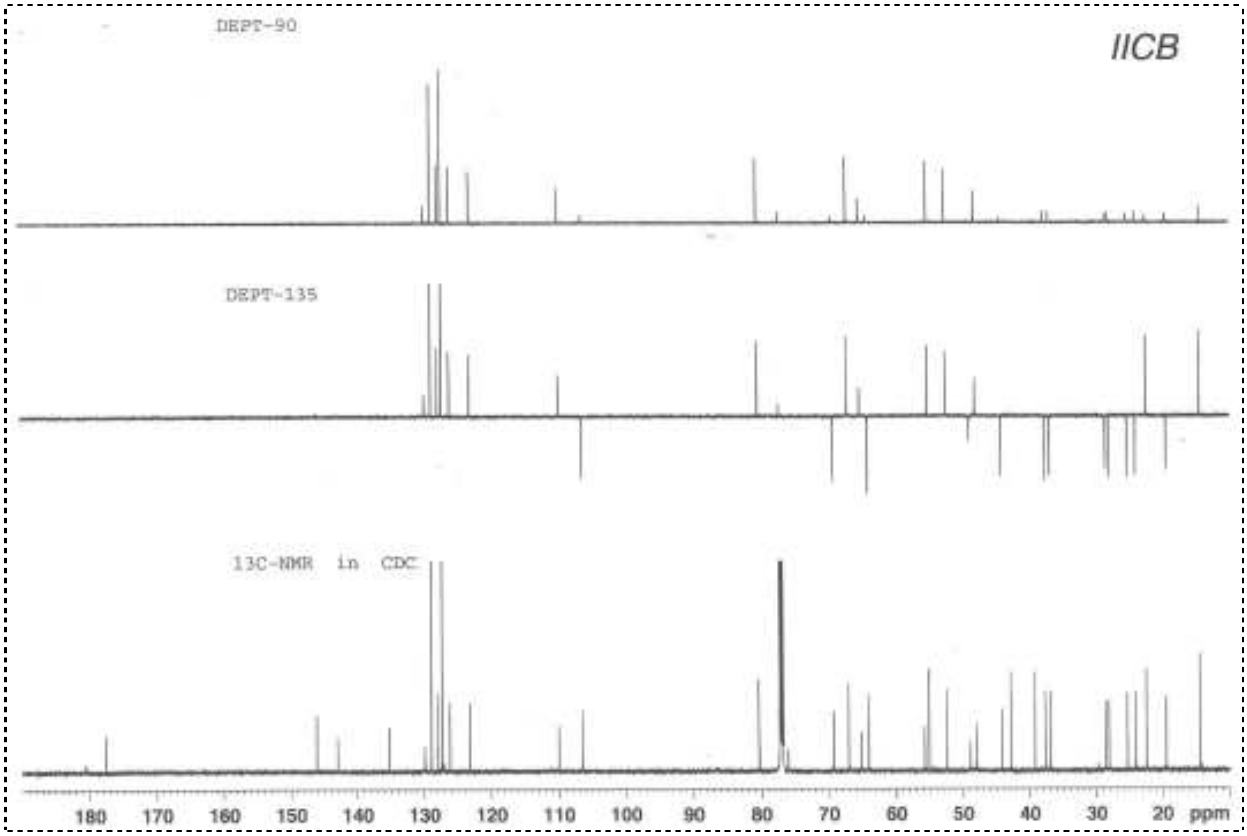

13C-NMR in DMSO
179.19
177.11
146.91
143.34
133.36
130.01
129.98
128.69
126.85
126.49
126.32
123.72
110.03
105.71
78.20
75.37
68.73
66.58
64.81
62.57
55.38
54.78
51.68
49.06
48.09
42.26
40.06
39.94
39.80
39.66
39.52
39.45
39.38
39.31
39.24
39.16
39.10
37.84
36.35
31.56
31.31
29.44
29.02
28.72
28.52
27.87
27.86
25.00
24.26
23.00
22.12
19.18
14.13
13.99
ppm
4i
IICB

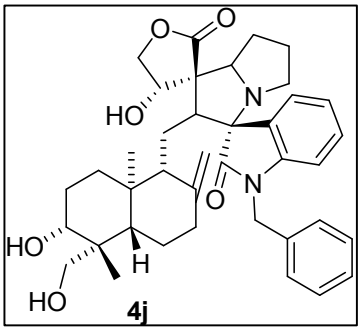

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

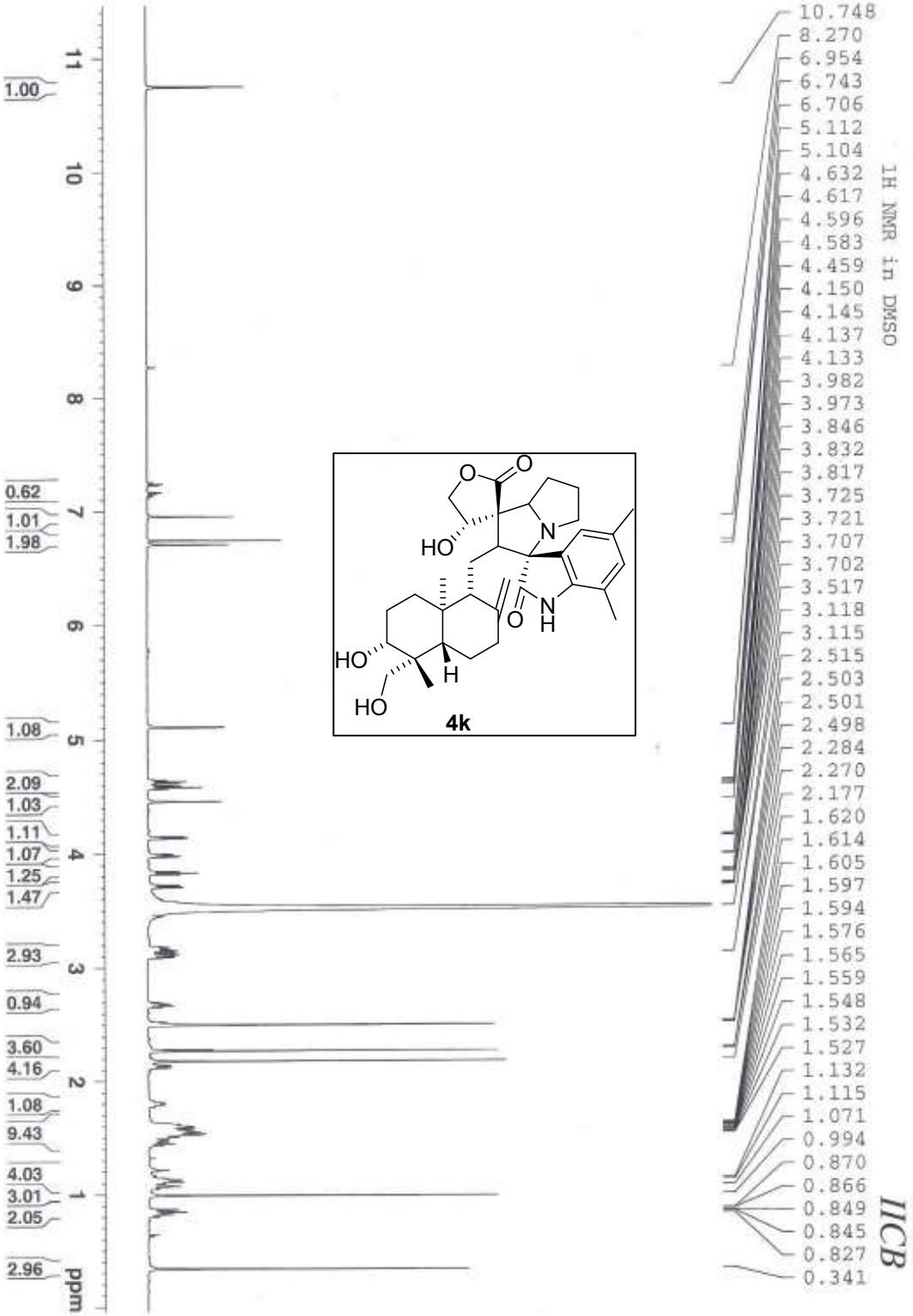

O
O
HO
N
N
O
HO
H
HO
4i

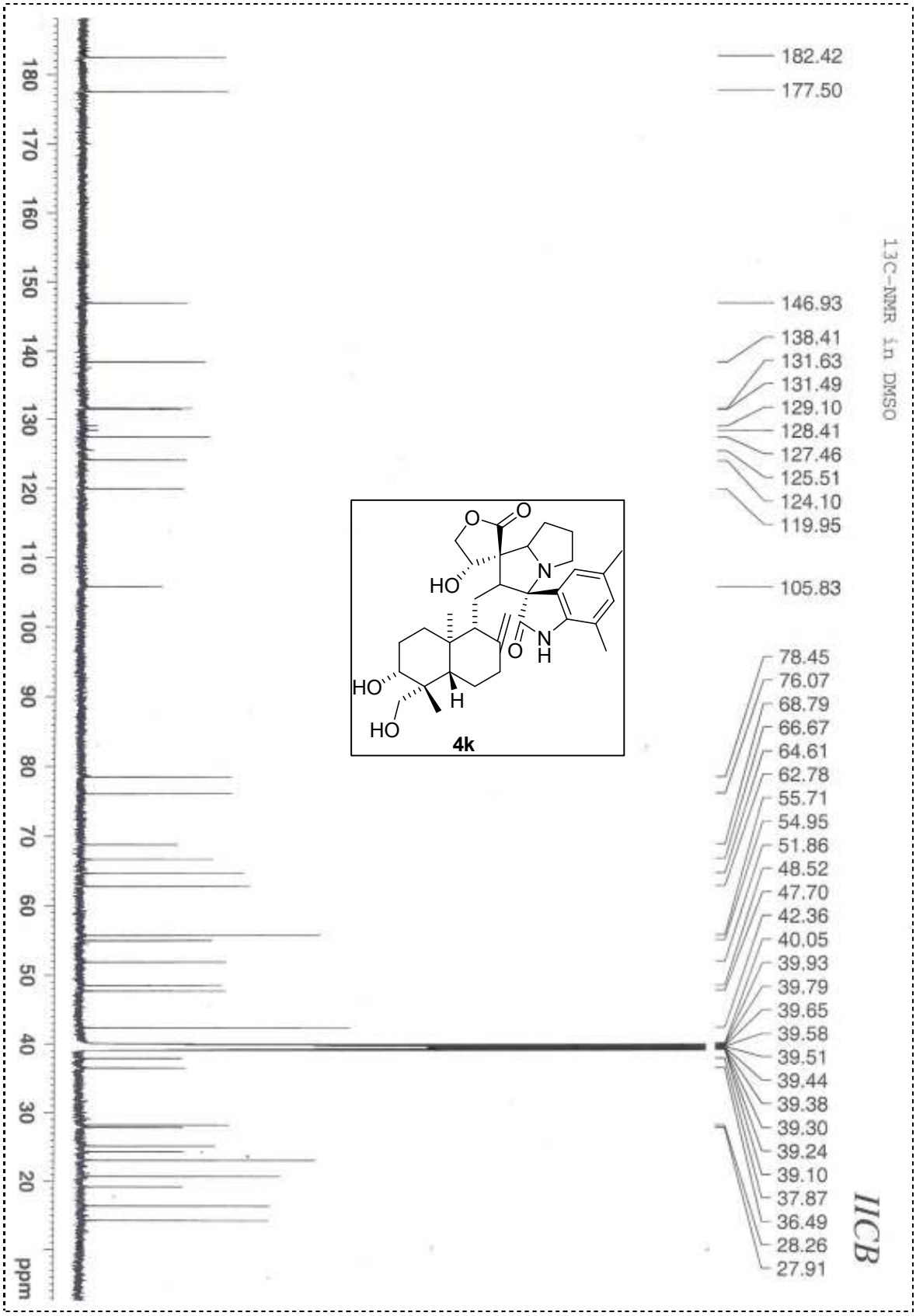

1H NMR in CDCl3
7.306
7.302
7.300
7.298
7.294
7.287
7.281
7.273
7.265
7.171
7.160
7.148
7.136
6.852
6.839
6.784
5.118
5.092
4.832
4.817
4.675
4.649
4.615
4.601
4.588
4.522
4.076
4.057
4.003
3.988
3.973
3.464
2.224
1.794
1.787
1.776
1.770
1.755
1.749
1.729
1.712
1.707
1.701
1.657
1.649
1.638
1.230
1.210
1.178
1.063
1.043
1.030
1.028
0.840
0.315
0.000
IICB
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
6.06
2.03
1.00
0.84
0.97
1.01
1.01
0.99
0.98
0.83
0.97
0.98
0.97
1.04
0.96
0.96
2.73
0.78
0.98
0.95
2.01
5.81
2.78
1.08
2.95
2.90
1.13
2.95
O
O
HO
N
N
O
HO
H
HO
4j

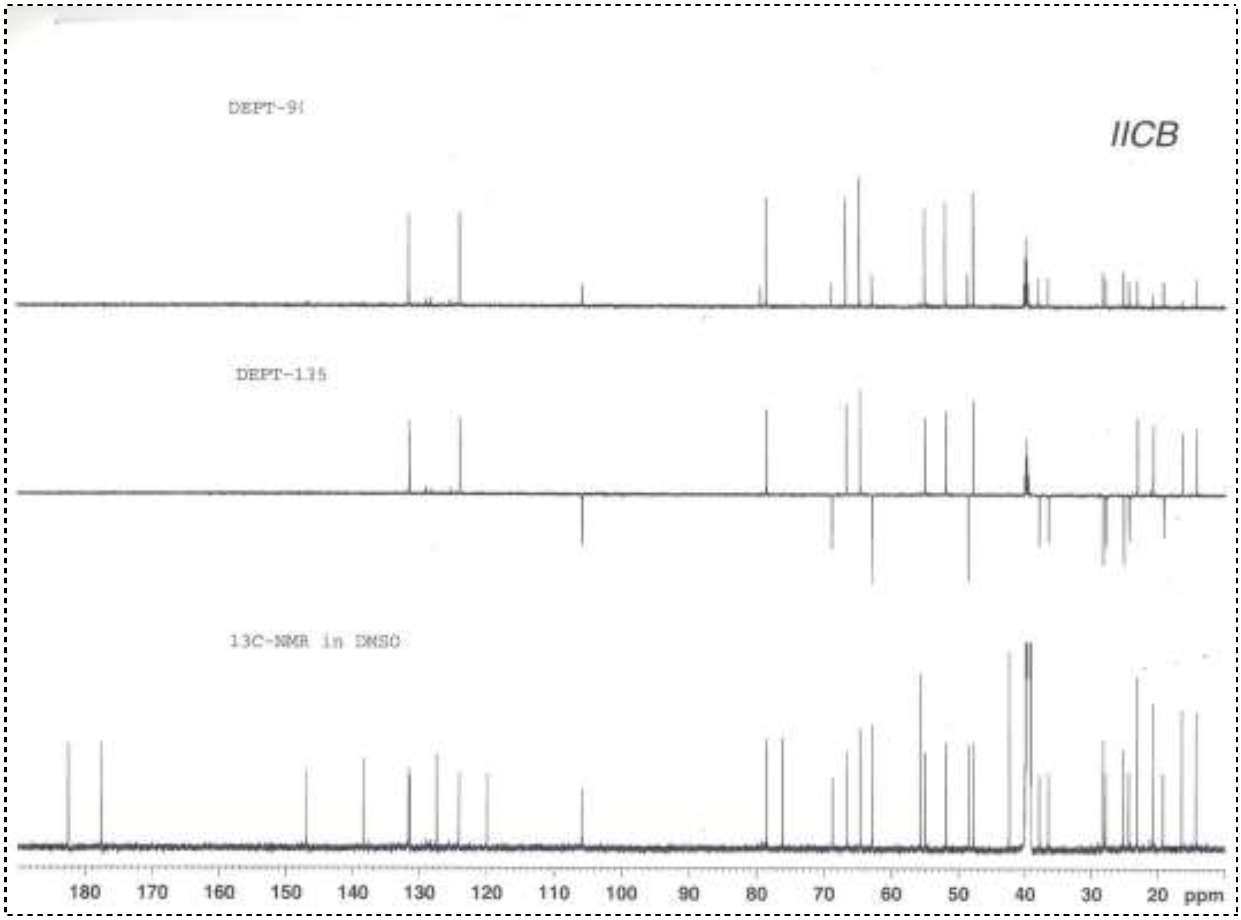

13C-NMR in CDCl3
177.48
146.14
143.01
135.25
129.91
128.95
127.91
127.37
126.18
123.15
110.01
106.50
80.37
77.21
77.00
76.79
75.99
69.27
67.03
65.22
64.05
55.73
55.08
52.40
48.90
48.05
44.16
42.85
39.21
37.70
36.90
28.59
28.13
25.34
24.06
22.49
19.47
14.44
-0.02
IICB
ppm
4j

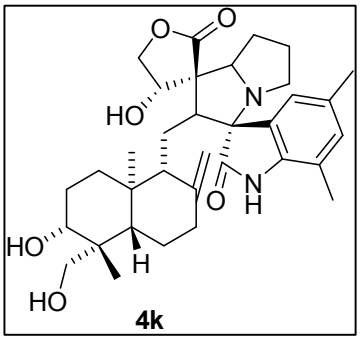

DEPT-90
IICB
DEPT-135
13C-NMR in CDC
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
HO
N
N
O
HO
H
HO
4j

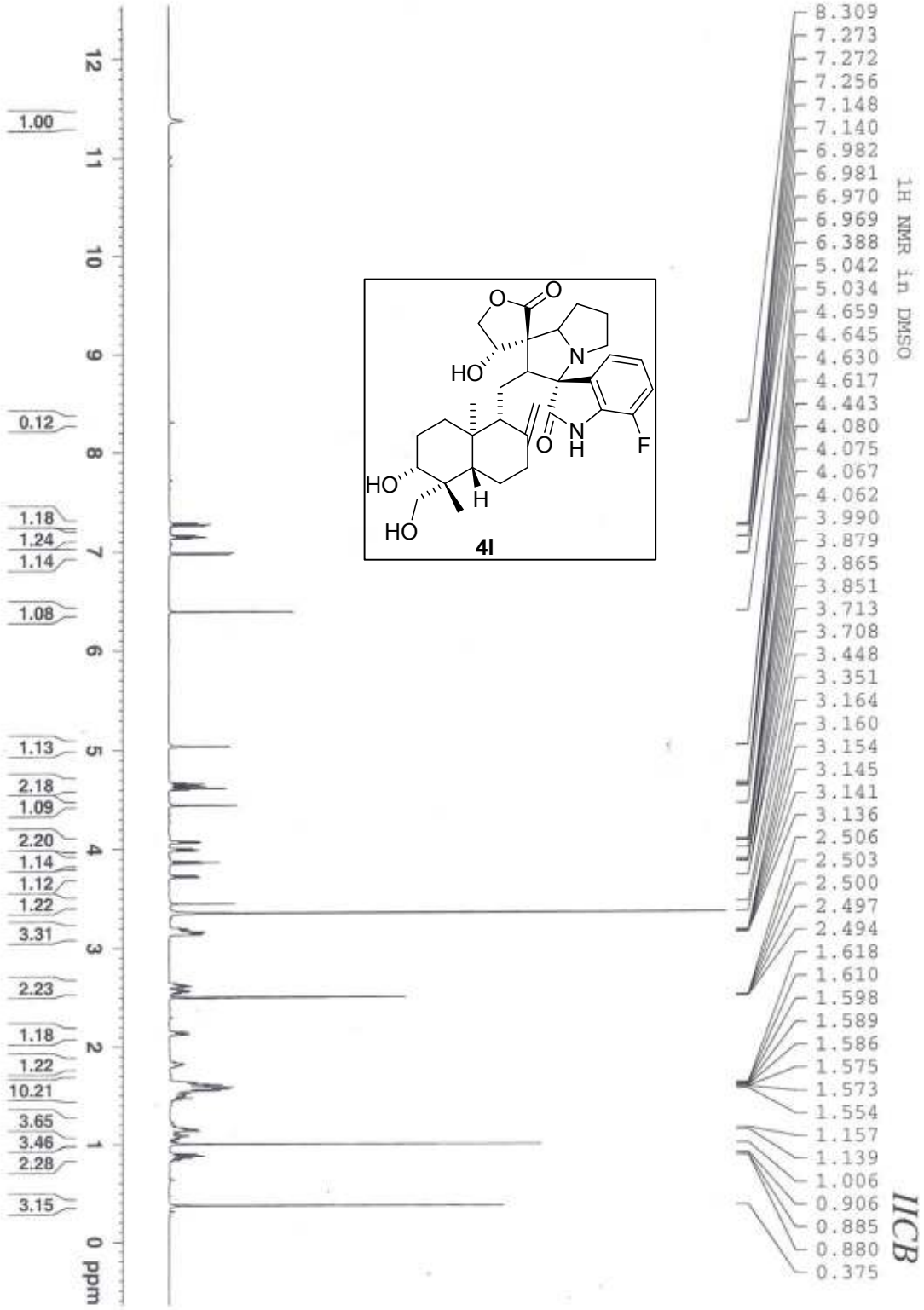

1H NMR in DMSO
10.748
8.270
6.954
6.743
6.706
5.112
5.104
4.632
4.617
4.596
4.583
4.459
4.150
4.145
4.137
4.133
3.982
3.973
3.846
3.832
3.817
3.725
3.721
3.707
3.702
3.517
3.118
3.115
2.515
2.503
2.501
2.498
2.284
2.270
2.177
1.620
1.614
1.605
1.597
1.594
1.576
1.565
1.559
1.548
1.532
1.527
1.132
1.115
1.071
0.994
0.870
0.866
0.849
0.845
0.827
0.341
IICB
1.00
0.62
1.01
1.98
1.08
2.09
1.03
1.11
1.07
1.25
1.47
2.93
0.94
3.60
4.16
1.08
9.43
4.03
3.01
2.05
2.96
ppm
11
10
9
8
7
6
5
4
3
2
1
O
O
HO
N
N
H
O
HO
H
HO
4k

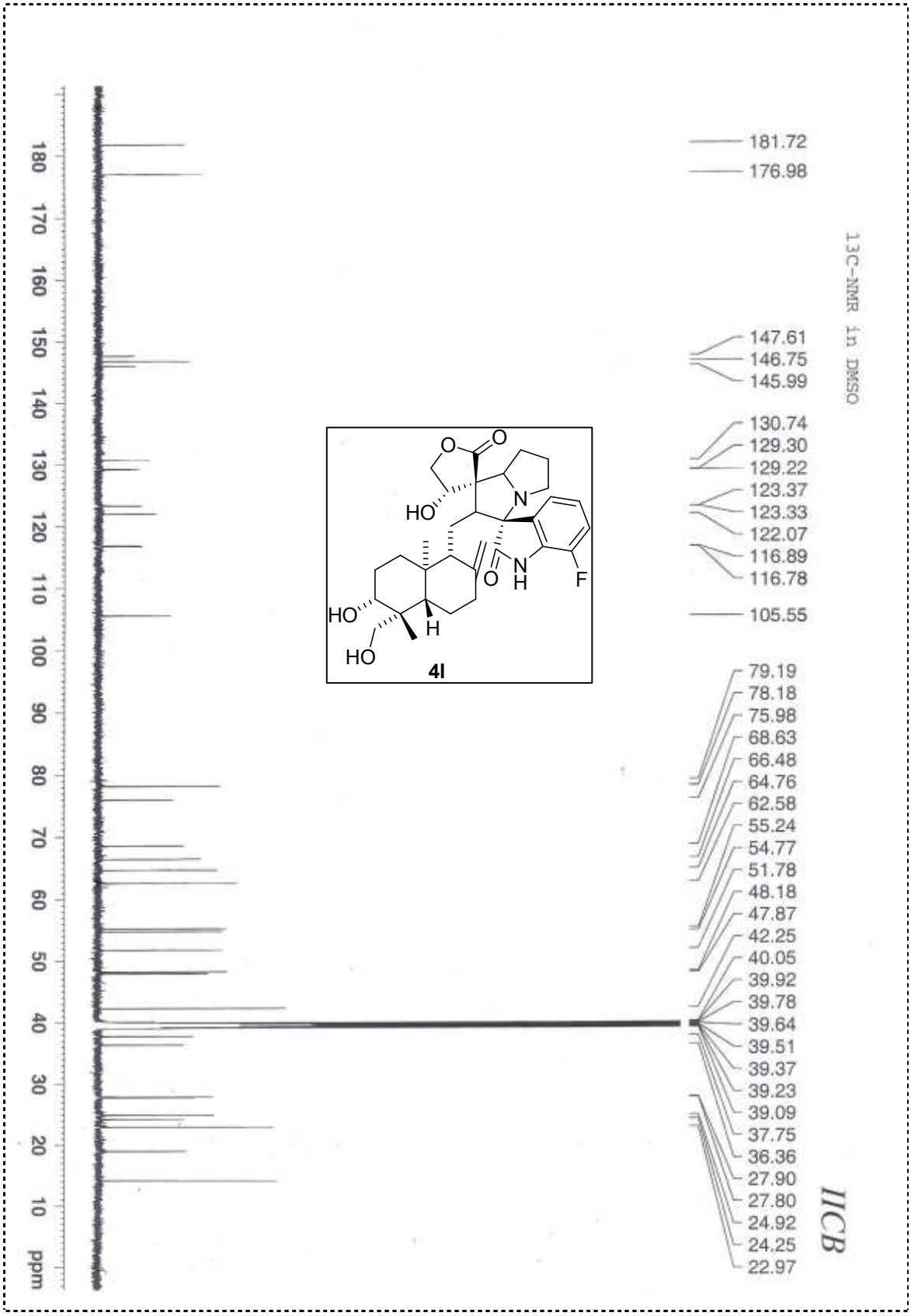

13C-NMR in DMSO
182.42
177.50
146.93
138.41
131.63
131.49
129.10
128.41
127.46
125.51
124.10
119.95
105.83
78.45
76.07
68.79
66.67
64.61
62.78
55.71
54.95
51.86
48.52
47.70
42.36
40.05
39.93
39.79
39.65
39.58
39.51
39.44
39.38
39.30
39.24
39.10
37.87
36.49
28.26
27.91
IICB
ppm
4k

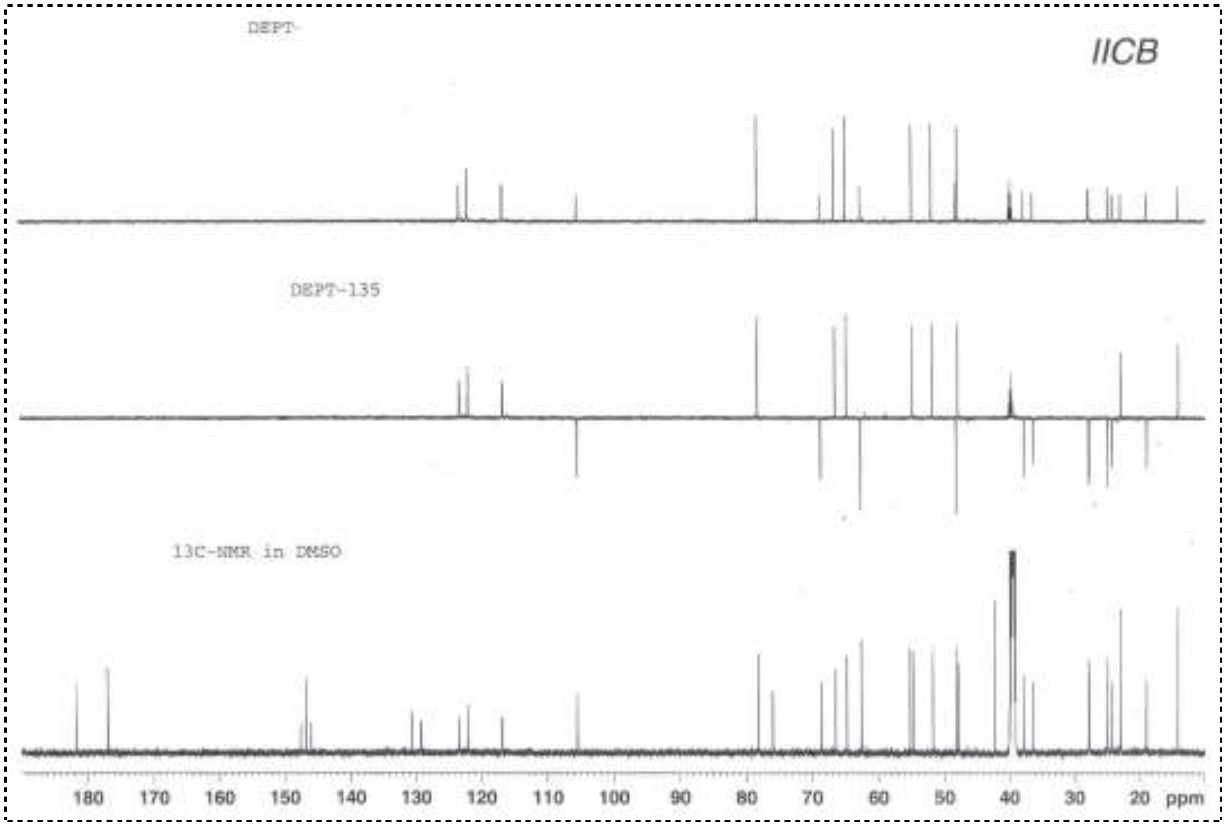

DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

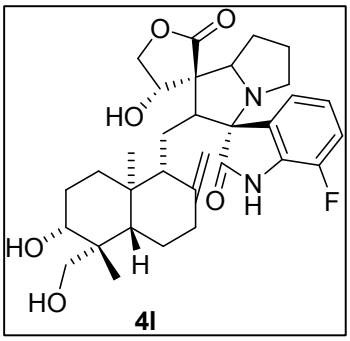

O
O
HO
N
N
H
O
HO
H
HO

4k

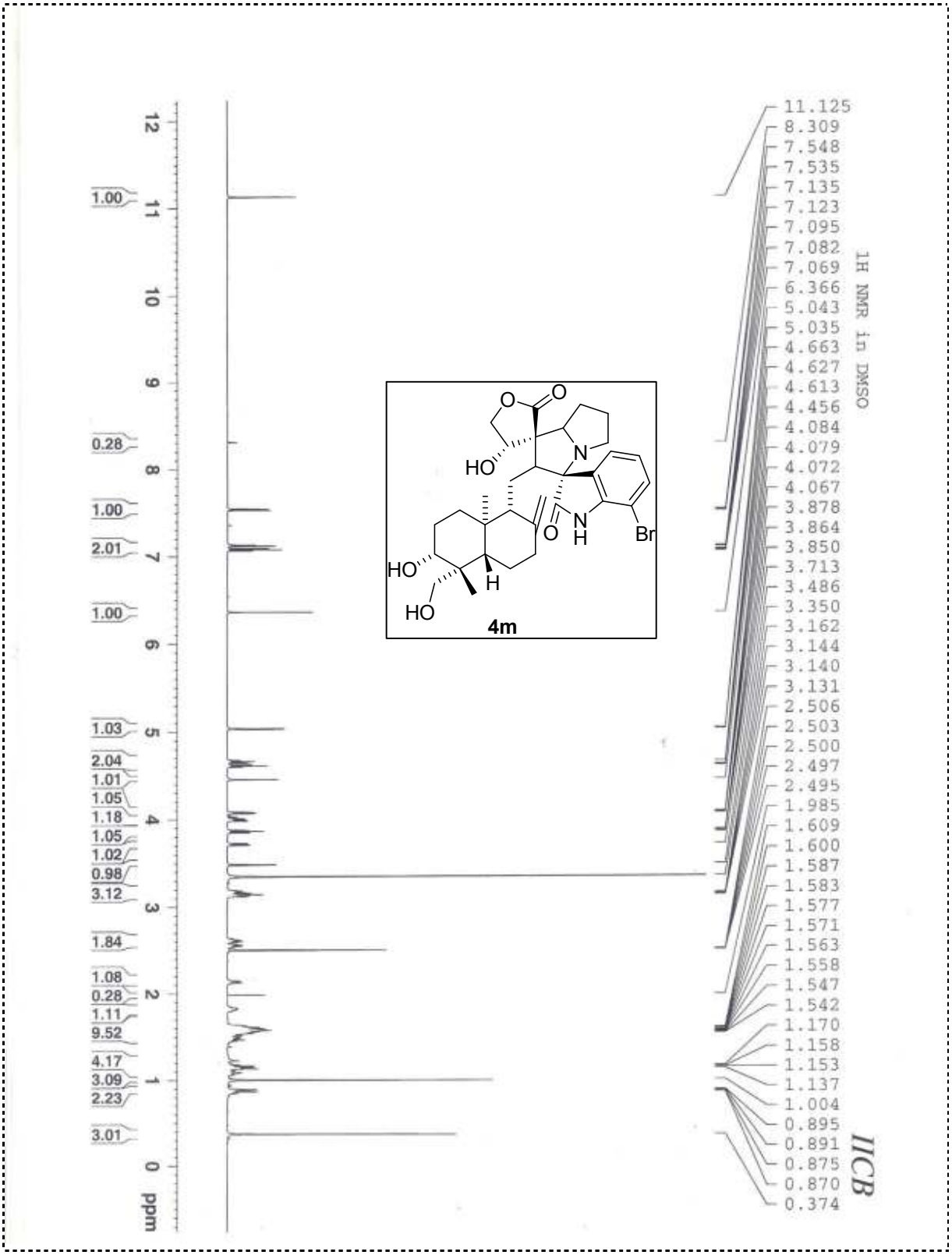

1H NMR in DMSO
8.309
7.273
7.272
7.256
7.148
7.140
6.982
6.981
6.970
6.969
6.388
5.042
5.034
4.659
4.645
4.630
4.617
4.443
4.080
4.075
4.067
4.062
3.990
3.879
3.865
3.851
3.713
3.708
3.448
3.351
3.164
3.160
3.154
3.145
3.141
3.136
2.506
2.503
2.500
2.497
2.494
1.618
1.610
1.598
1.589
1.586
1.575
1.573
1.554
1.157
1.139
1.006
0.906
0.885
0.880
0.375
1.00
0.12
1.18
1.24
1.14
1.08
1.13
2.18
1.09
2.20
1.14
1.12
1.22
3.31
2.23
1.18
1.22
10.21
3.65
3.46
2.28
3.15
12
11
10
9
8
7
6
5
4
3
2
1
0 ppm
O
O
HO
N
O
N
H
F
HO
H
HO
4l
IICB

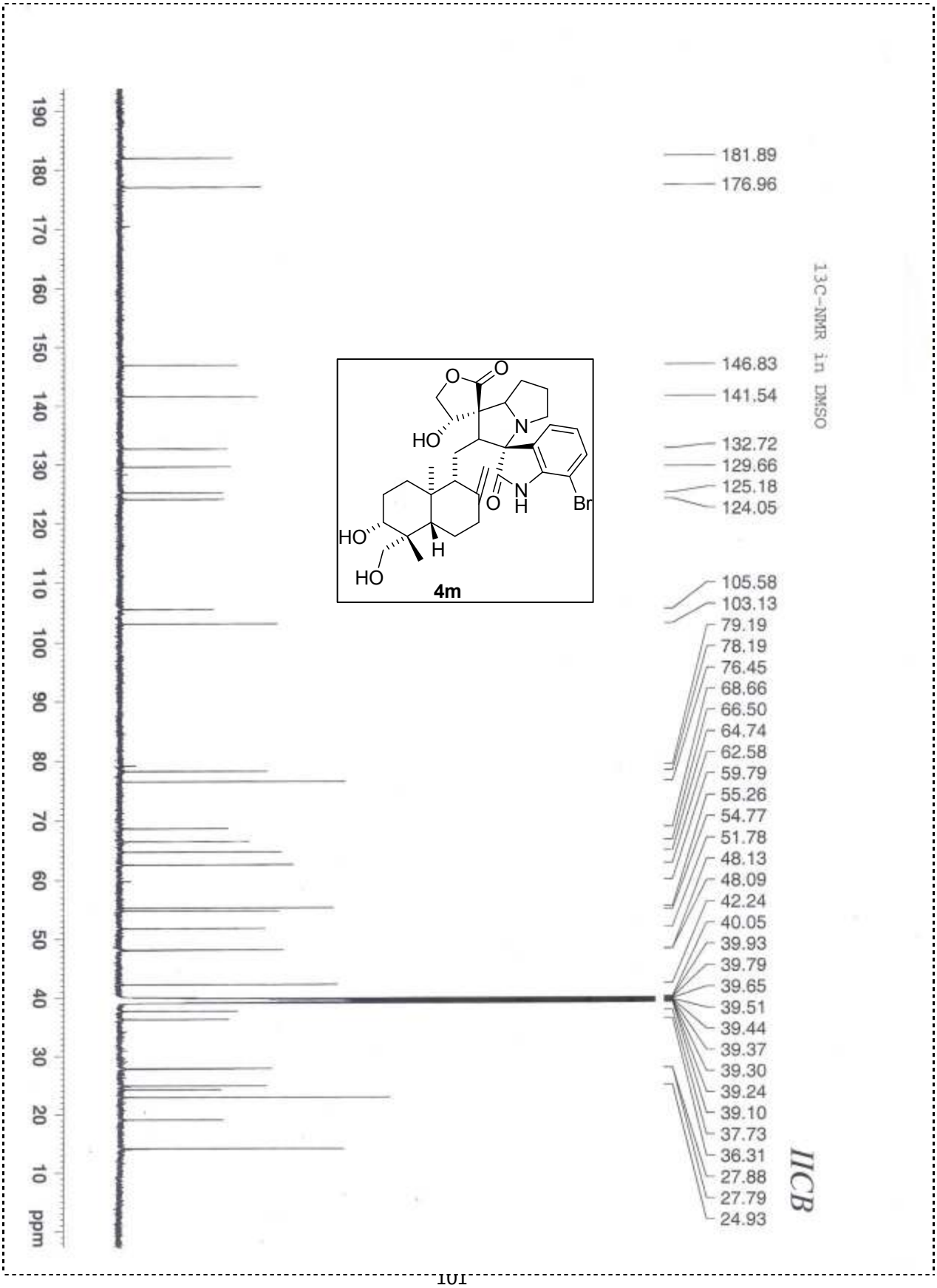

13C-NMR in DMSO
181.72
176.98
147.61
146.75
145.99
130.74
129.30
129.22
123.37
123.33
122.07
116.89
116.78
105.55
79.19
78.18
75.98
68.63
66.48
64.76
62.58
55.24
54.77
51.78
48.18
47.87
42.25
40.05
39.92
39.78
39.64
39.51
39.37
39.23
39.09
37.75
36.36
27.90
27.80
24.92
24.25
22.97
IICB
ppm
4l

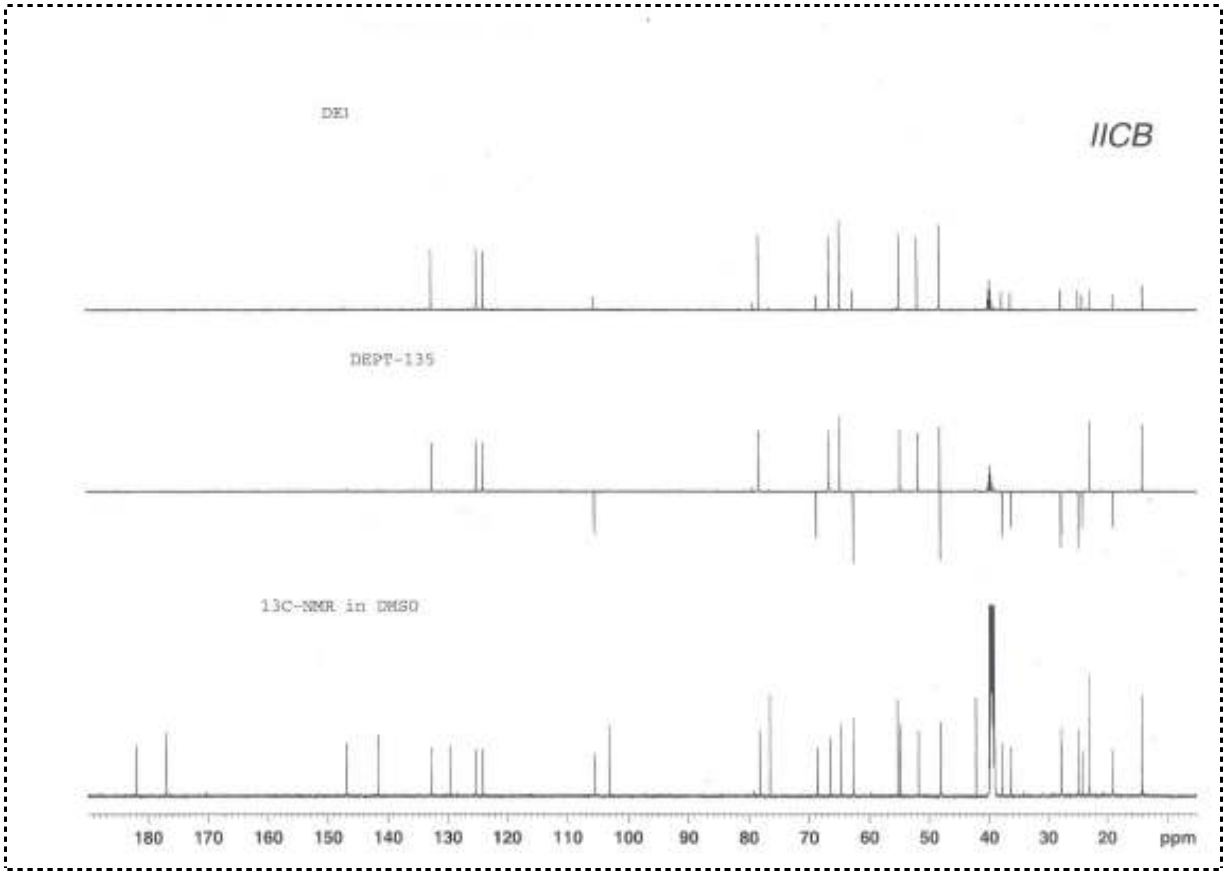

DEPT
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

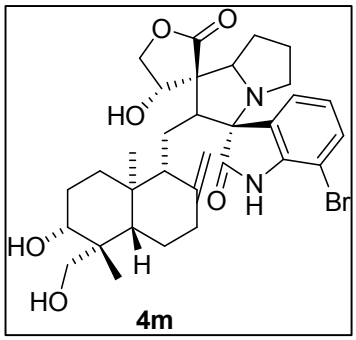

O
O
HO
N
O
N
H
F
HO
H
HO

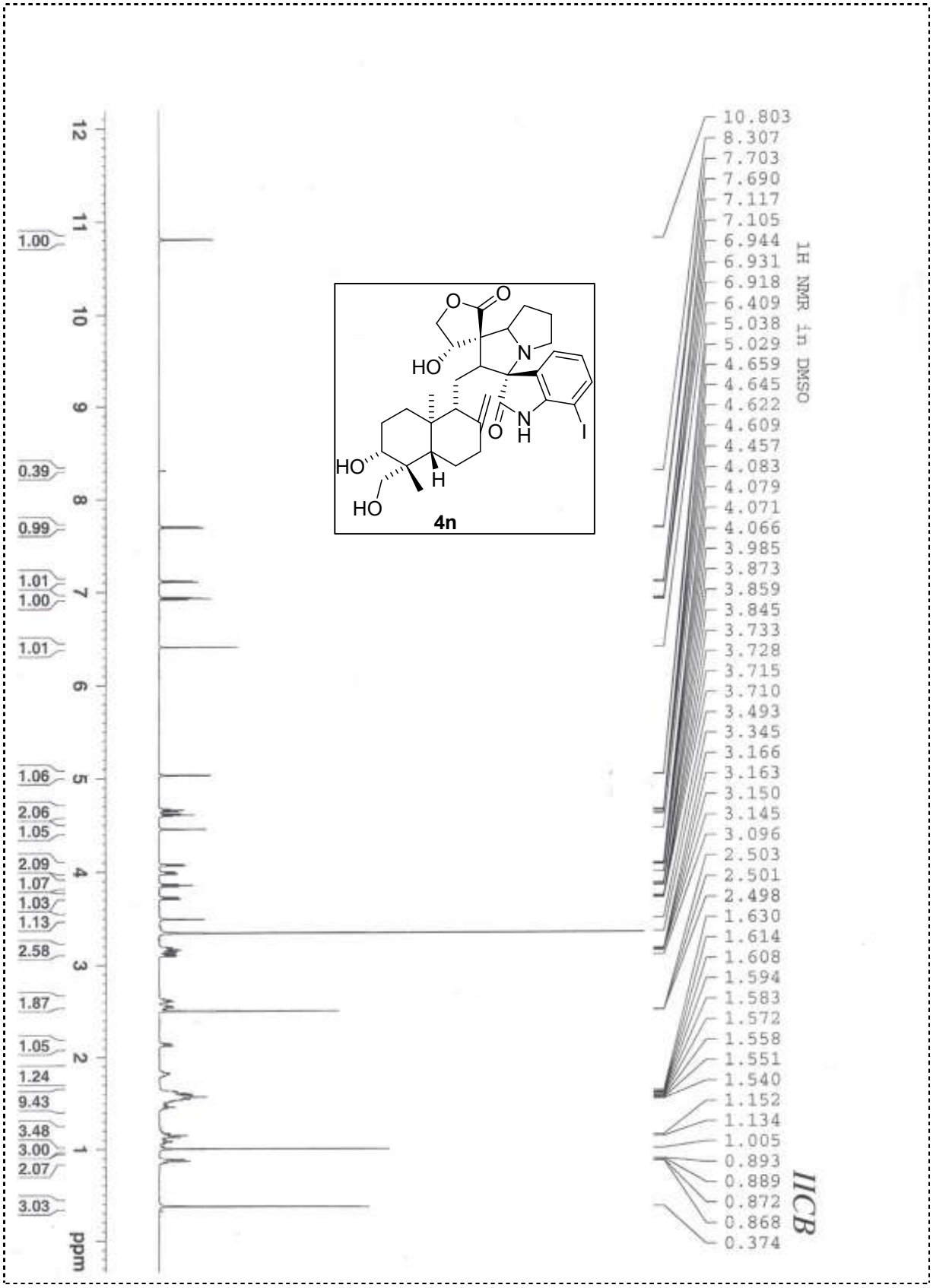
4l

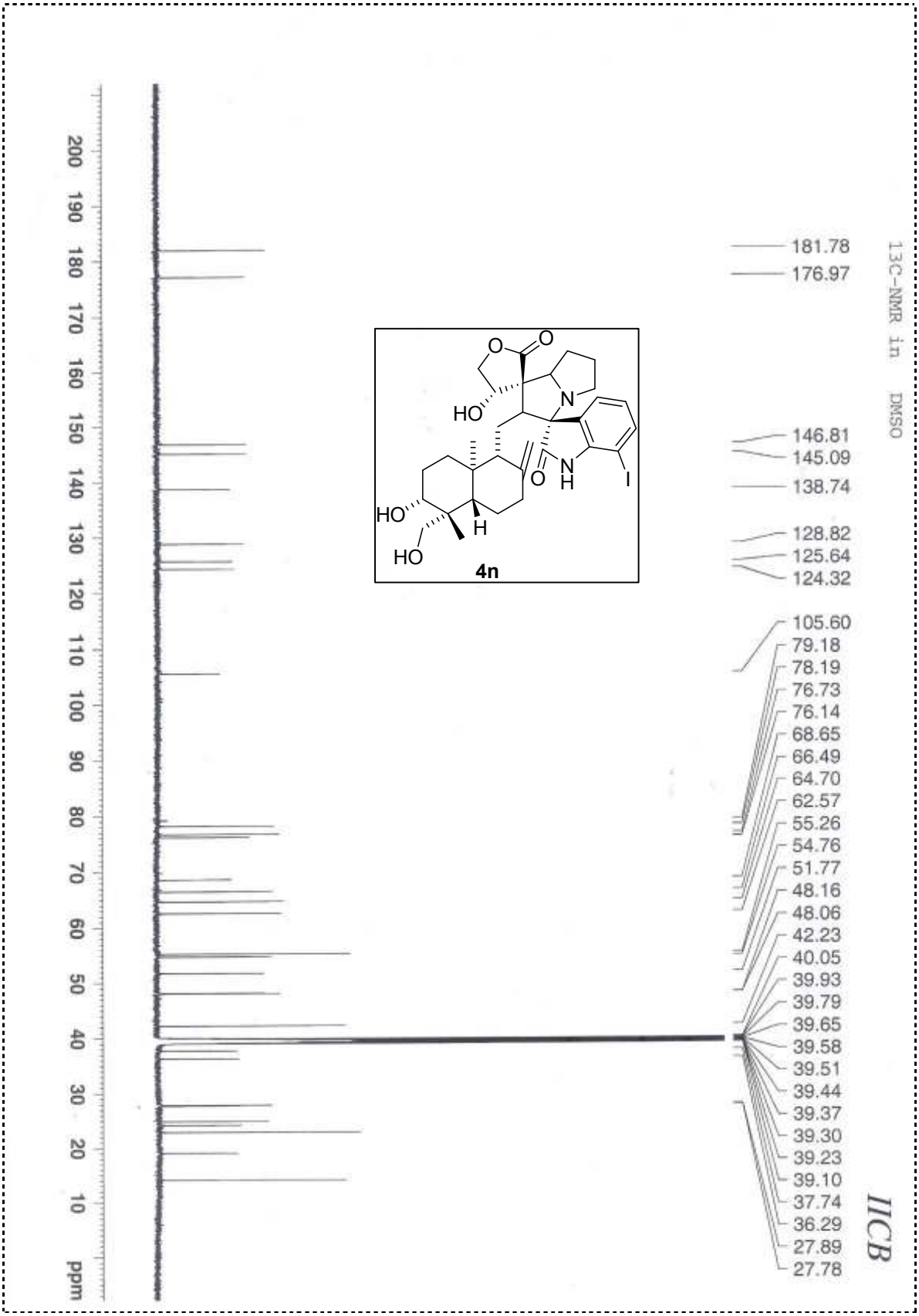

1H NMR in DMSO
11.125
8.309
7.548
7.535
7.135
7.123
7.095
7.082
7.069
6.366
5.043
5.035
4.663
4.627
4.613
4.456
4.084
4.079
4.072
4.067
3.878
3.864
3.850
3.713
3.486
3.350
3.162
3.144
3.140
3.131
2.506
2.503
2.500
2.497
2.495
1.985
1.609
1.600
1.587
1.583
1.577
1.571
1.563
1.558
1.547
1.542
1.170
1.158
1.153
1.137
1.004
0.895
0.891
0.875
0.870
0.374
IICB
ppm
12
11
10
9
8
7
6
5
4
3
2
1
0
1.00
0.28
1.00
2.01
1.00
1.03
2.04
1.01
1.05
1.18
1.05
1.02
0.98
3.12
1.84
1.08
0.28
1.11
9.52
4.17
3.09
2.23
3.01
O
O
HO
N
N
H
O
Br
HO
H
HO
4m

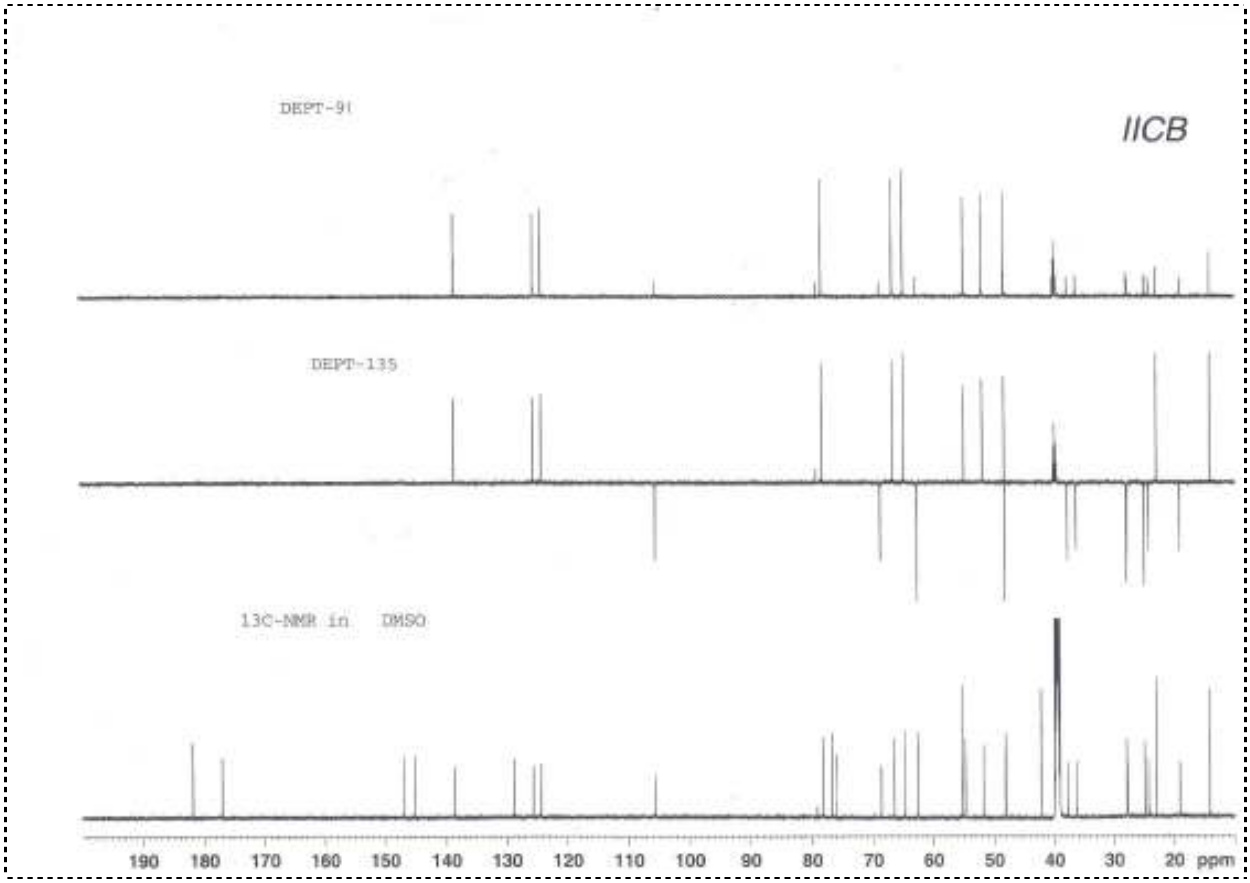

13C-NMR in DMSO
181.89
176.96
146.83
141.54
132.72
129.66
125.18
124.05
105.58
103.13
79.19
78.19
76.45
68.66
66.50
64.74
62.58
59.79
55.26
54.77
51.78
48.13
48.09
42.24
40.05
39.93
39.79
39.65
39.51
39.44
39.37
39.30
39.24
39.10
37.73
36.31
27.88
27.79
24.93
IICB
4m
ppm

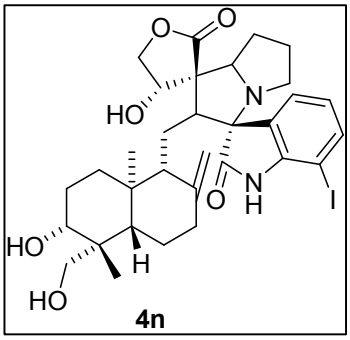

DEI
IICB
DEPT-135
13C-NMR in DMSO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
HO
N
N
H
O
Br
HO
H
HO
4m


1H NMR in DMSO
10.803
8.307
7.703
7.690
7.117
7.105
6.944
6.931
6.918
6.409
5.038
5.029
4.659
4.645
4.622
4.609
4.457
4.083
4.079
4.071
4.066
3.985
3.873
3.859
3.845
3.733
3.728
3.715
3.710
3.493
3.345
3.166
3.163
3.150
3.145
3.096
2.503
2.501
2.498
1.630
1.614
1.608
1.594
1.583
1.572
1.558
1.551
1.540
1.152
1.134
1.005
0.893
0.889
0.872
0.868
0.374
IICB
4n
ppm


13C-NMR in DMSO
181.78
176.97
146.81
145.09
138.74
128.82
125.64
124.32
105.60
79.18
78.19
76.73
76.14
68.65
66.49
64.70
62.57
55.26
54.76
51.77
48.16
48.06
42.23
40.05
39.93
39.79
39.65
39.58
39.51
39.44
39.37
39.30
39.23
39.10
37.74
36.29
27.89
27.78
IICB
ppm
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
O
O
HO
N
N
H
O
I
HO
H
HO
4n


DEPT-90
IICB
DEPT-135
13C-NMR in DMSO
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


O
O
HO
N
O
N
H
I
HO
H
HO
4n